670

THE MONTHLY

Review

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Starting July 2, 1945 the publishing and advertising offices of the REVIEW and the A. E. S. Executive Offices will be located at 471 York Road, Jenkintown, Pennsylvania. Mailing address — P. O. Box 168.

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JULY ✦ ✦ ✦ 1945

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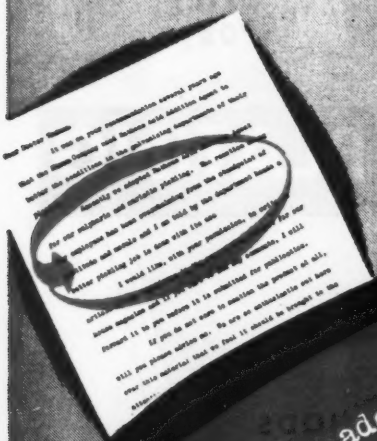

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Entered as second class matter July 20, 1945, at the post office at Paterson, N. J., under Act of August 24, 1912.

THE PRESIDENT'S MESSAGE

EACH member of the American Electroplaters' Society can be justly proud of the record made by this organization over the past few years in moving forward toward its proper place and recognition as the finest existing source of technical information on metal finishing. By that very token, each member is faced with a challenge to not only maintain but to advance our position as an educational organization. This is not a job or a function only of the Executive Officers, the publication's Editor and the Research Committee. It is a function of each member regardless of his position in the Society.

Many have taken occasion in the past to criticize the technical material in the MONTHLY REVIEW. Not infrequently, certain papers presented at our conventions have been held to be inferior. Such criticisms are steadily becoming less in number, but they still exist. As long as any exist, progress must be made to eliminate them. This progress is possible only through the effort of each member to get good technical material into the possession of the Educational Chairman or the Editor of the MONTHLY REVIEW. Admittedly, a great many members either cannot, for one reason or another, or will not write papers. These men can help by urging others who can to do so.

It is the fond hope of the present administration that the time is imminent when our offices will be flooded with articles which after proper review and editing will permit the finest information to be published by our Society. This situation would be far different from that which has existed in the past when the MONTHLY REVIEW has lived almost literally from "hand to mouth" as far as technical articles are concerned. This new situation means progress; it means more value and education for you as a member; it means more for the outside world to witness as a sign of growth of a fine organization and it is the number one item in the program of the present administration. As President, I urgently request your cooperation.

W. L. PINNER

ANNUAL BUSINESS MEETING

THE 33rd annual business meeting of the A.E.S. was held at the Hotel William Penn, Pittsburgh, Pa., Monday, June 18, 1945. Owing to the inability to hold the educational sessions, this meeting lacked the color of our usual annual meeting. The entertainment, good fellowship, contacts among our large number of friends and the ladies' company were conspicuously absent. Instead, a serious discussion of the affairs of the Society occupied the delegates in both morning and afternoon sessions.

After the reports of the various officers and committees, the amendment with respect to changing the Constitution were presented. The Newark amendment which provides for three classes of membership, namely, Honorary, Active and Sustaining, was passed. Owing to a technicality in the wording of the amendment, the Sustaining Members would have the same voting privileges as the Active Members. To correct this defect in the amendment it was voted that the Newark Branch prepare an amendment to be submitted for a referendum vote.

Also passed was the amendment by the Baltimore-Washington Branch, for reorganization of the Research Committee so that ultimately each committee member will serve three years and three of the nine members will be appointed each year.

It was agreed to continue Pittsburgh as the Convention City for 1946 and the Hotel William Penn as the Convention Hotel June 17 to 20 are the dates chosen.

The Secretary was authorized to place an order for Society pins which can be purchased by the members. Pins for National Officers will bear distinguishing marks.

Sylvester P. Gartland was elected an honorary member.

There was no Proctor Award and no Exhibit Award in the absence of these usual convention activities.

The first prize of $50.00 for the best paper presented during the year in the MONTHLY REVIEW was awarded to Messrs. Pinner and Kinnaman for their very excellent paper "High Speed Nickel Plating."

The Society Gold Medal for the second prize was awarded to Dr. D. G. Foulke for his excellent series of papers on the analysis of impurities in nickel plating baths.

The officers and delegates were guests of *Metal Finishing* at luncheon at which Tom Trumbour proved to be a very successful host.

The following officers were nominated and elected unanimously:

President—Walter L. Pinner
First Vice-President—Frank K. Savage
Second Vice-President—
Raymond J. O'Connor
Third Vice-President—Kenneth M. Huston

The President announced the change in the offices of Secretary and Business Manager in which A. Kenneth Graham will assume the duties of Executive Secretary, July 2, 1945 and W. C. Pinkerton will assume duties of Busines Manager for the REVIEW.

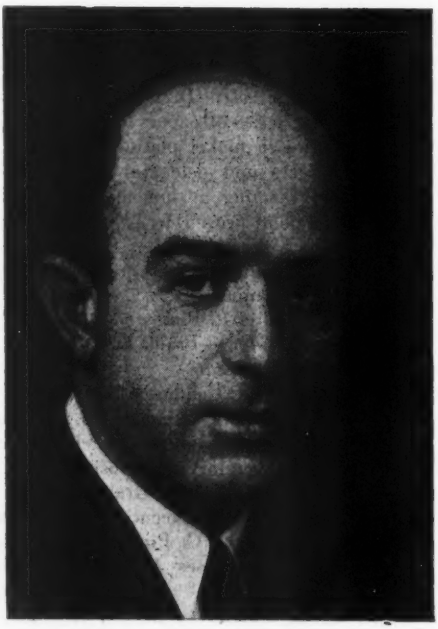
Mr. E. T. Candee addressed the delegates after the announcement of these changes and outlined the accomplishments during his terms of office as Secretary.

The Research Committee for 1945-46 is as follows:

W. L. PINNER, *President*, Ex Officio
Houdaille-Hershey Corp.
A. K. GRAHAM, Executive Secretary
Graham, Crowley & Associates, Inc.
3 Years:
W. BLUM ..... National Bureau of Standards
R. M. WICK ..... Bethlehem Steel Co.
E. T. CANDEE ..... American Brass Co.
2 Years:
W. A. WESLEY ..... International Nickel Co.
M. R. CALDWELL ..... Doehler-Jarvis Corp.
C. E. HEUSSNER ..... Chrysler Corp.
1 Year:
F. K. SAVAGE ..... C. G. Conn, Ltd.
W. M. PHILLIPS ..... General Motors Corp.
F. C. MESLE ..... Oneida, Ltd.

This committee meets Saturday, July 14th at the Statler Hotel, Buffalo, N. Y. for its organization meeting and to elect a chairman for the coming year.

National Officers



WALTER L. PINNER
Supreme President

Born 1901 at Montgomery, Ala. Completed H. S. 1918 and received B.S.E. degree, University of Michigan, 1923. On graduation was employed by C. G. Spring Co., a division of the Houdaille-Hershey Corporation and now holds position of Chief Chemical Engineer in this Corporation. Has published a number of papers on plating and related matters. Has now won four Gold Medal Awards of the A.E.S. President of Detroit Branch two years and has held various offices. Served as Secretary of the Electrodeposition Division of the Electrochemical Society. Is a member of A.S.M.

FRANK K. SAVAGE
First Vice-President

Holds a B.S. degree in Chemical Engineering, Michigan State College, 1935. Employed by C. G. Conn., Ltd., 1935 as Chemist. Advanced to Plating Room Foreman, 1937. Chief Chemist in charge of Research and Development, 1939 and since 1942 has been serving as General Superintendent.

Was President of Chicago Branch, 1941-42. Received Ch.E. professional degree, Michigan State College, 1941.

Has served ably on A.E.S. Research Committees, 1944-45.

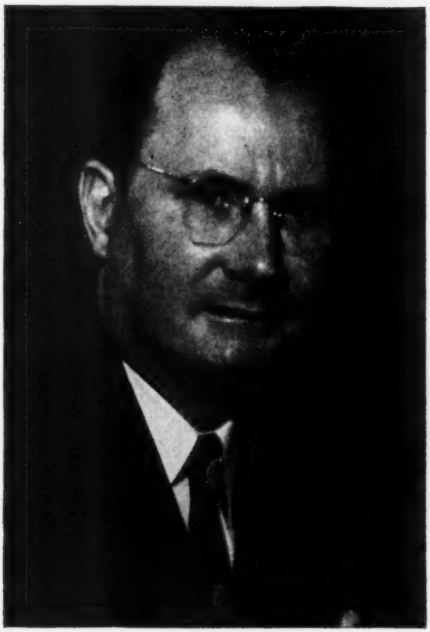
During past year as Vice-President in Charge of Membership, the Society has grown substantially.

A. E. S. 1945-1946

Born May 7, 1895, Naugatuck, Conn. Educated in schools of Naugatuck and Waterbury, Conn.

Employed in Laboratory, Chase Brass of Waterbury, Conn., 1910-16. Served as Chief Chemist, Conn. Brass & Mfg. Co., Waterbury 1916-19. Laboratory Technician, Bridgeport Brass Co., 1919-21. Joined Contract Plating Co., Inc., Stratford, Conn., 1921 and now holds position of President and Treasurer.

Served as Chairman of Research Committee, 1925-30. Also served as 1st Vice-President of the A.E.S. in 1930.



RAYMOND J. O'CONNOR
Second Vice-President

Born in Brazil, Ind. Graduated Wiley H. S., Terre Haute, Ind. B.S. in Ch.E., Rose Polytechnic Institute, Terre Haute, Ind., 1920.

Employed as Jr. Eng., Empire Gas & Fuel Co. Anal. Chem. and Asst., to Technical Director, C. W. S., Edgewood Arsenal, Md. Office Chief, C. W. S., preparing procurement plans for critical and strategic materials. Served as engineer, manufacturing planning engineer and development engineer, Western Electric Co., Inc., Baltimore, Md. At present Finishing Engineer for plated and organic finishes.

President Baltimore-Washington Branch, A.E.S., 1944-46. Member of Alpha Chi Sigma and American Legion.

KENNETH M. HUSTON
Third Vice-President

A. KENNETH GRAHAM
Executive Secretary
and Publisher of the Review

Born December 25, 1896, Philadelphia, Pa. Attended University of Pennsylvania and Columbia University. Holds B.S., M.S., and Ph.D. from University of Pennsylvania.

Research work, Scovill Mfg. Co., Waterbury, Conn., 1919-20. Instructor in Chemistry, University of Pennsylvania, 1921-26. Chemical Engineer H.V.W.M. Co., 1926-28. Instructor and Assistant Professor in chemical engineering, University of Pennsylvania, 1928-37. Consultant, A. K. Graham & Associates, 1936-42. Consultant and Department Chief, Products Branch, Cons. Div. W.P.B., 1942-43. Director of Research and Development, Garfield Div., Houdaille-Hershey Corp., 1943-44. President, Graham, Crowley & Associates, Inc., 1944 to date.

Twice recipient of A.E.S. Gold Medal Award.

NEW APPOINTMENTS

The Society is fortunate in obtaining the services of K. G. Soderberg to serve as Assistant Editor of the MONTHLY REVIEW and W. C. Pinkerton to serve as Business Manager for the MONTHLY REVIEW. The former, a graduate of several Swedish colleges and technical schools, is well known to members of the A.E.S. having gained recognition as a technical leader in the field of electrodeposition while serving as Technical Director, Udylite Corp., Detroit, Mich. and subsequently as consultant, Conservation Division, W.P.B., Washington, D. C. He is equally well known for his numerous contributions to the literature on electrodeposition, corrosion and related subjects.

The latter, a graduate of Pratt Institute, has had extensive experience in advertising and publishing activities having formerly been employed by Reinhold Publishing Co. and International Nickel Co., both of New York City.

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Progress Report Number Two:

A.E.S. Research Project Number 1, on "STRIPPING OF COPPER FROM VARIOUS BASE METALS"

Project Director: F. C. Mathers.
Associates: C. E. Landwerlen, E. L. Martin
Chemistry Department, University of Indiana, Bloomington, Indiana

EDITOR'S NOTE

The following introduction is an over simplified explanation of the factors involved in the stripping of metals. It must be recognized that it is impossible to generalize in any treatment of such a subject without making statements which would be subject to criticism from the viewpoint of corrosion theory. This is largely due to the great complicity of the reactions in different environments. However, it is submitted in the belief that it will assist those readers who are not too familiar with the basic principles involved.

INTRODUCTION

DIFFERENT metals dissolve at different rates in acids and other dissolving agents. The order of the metals for decreasing rate of attack in a solution is called an "activity series." The position of the metals in the series varies with the solution used. For most acids the order in the series is the same and similar to that of the "Electromotive Force Series." Metals that almost completely resist attack are often called noble metals. Gold and platinum are good examples of noble metals, while silver and copper are intermediate. Zinc, cadmium and magnesium are very readily attacked and, therefore, are active metals.

When two different metals are paired in a cell, the less noble metal normally acts as the anode or dissolving electrode and the more noble metal acts as the cathode or insoluble electrode. Often the metal that dissolves most readily will displace all the other metals which are less active from a solution by simple immersion. Examples are displacement of silver by copper from a silver cyanide solution and of copper by iron from a copper sulfate solution. In the latter case, copper is more noble and less active than iron. However, iron or even zinc will not displace copper from a cyanide solution because in cyanide and in various other alkaline solutions, iron is more noble than is copper.

Solution attack on a metal may decrease or cease after a short time due to other causes than lack of activity. The usual cause of this is the formation of some insoluble salt or film which coats the metal and protects it from further corrosion. Lead in sulfuric acid quickly becomes inactive due to the formation of a film of lead sulfate. Iron tank cars are used for concentrated sulfuric acid for a similar reason. Hydrochloric acid containing considerable quantities of arsenic or antimony dissolves iron only very slowly because the iron becomes covered with a protective thin layer of arsenic or antimony. In the above cases the metals in the solutions mentioned may be said to be more noble than usual. This shows that the solution may greatly influence the relative tendency of metals to dissolve.

In stripping electrodeposits, if the solution is such that the plate is only a little more rapidly soluble or active than the basis metal, it dissolves both metals but the basis metal at a slower rate. If the plate is less active and less readily soluble than the base metal, serious attack with pitting of the basis metal usually results before the plate is all removed.

An ideal stripping solution is one in which the electrodeposit dissolves very rapidly and the base metal very slowly. The greater the difference in dissolving rate between the plate and the basis metal the more successful is the solution in reference to basis metal attack. A stripping solution of sodium hydroxide is useless for a deposit of copper on aluminum. In this solution copper is much more noble than aluminum. On the other hand, such a

solution would work very well for a deposit of aluminum on copper. A nitric acid stripping solution reverses the dissolving tendency of the two metals and is suitable for stripping a deposit of copper from aluminum but would be useless for stripping a deposit of aluminum from copper.

In ordinary acids such as hydrochloric and sulfuric, the order of decreasing activity for some of the common metals is magnesium, aluminum, zinc, cadmium, iron, nickel, tin, lead, copper, mercury, silver and gold. This shows why there is difficulty in stripping copper from iron and zinc. Copper is more noble or less rapidly soluble in the ordinary acids.

A successful stripping solution for copper from a basis metal must be a solution in which the basis metal is more noble or below copper in the activity series and preferably one in which the basis metal will be entirely noble or completly unattacked. This object is attained in the case of iron in solutions wherein the iron is changed into a passive state. Several very strong oxidizing agents change iron to this state but do not passify other metals except cobalt and nickel to a limited extent. This explains the use of chromic acid, which makes iron passive, in so many stripping solutions. Strong nitric acid also passifies iron. The activity series in both dilute and concentrated nitric acid is tin, zinc, iron (ordinary), copper, lead, mercury, silver and iron (passive). This shows iron in the passive state as being the least soluble of the metals mentioned.

There are several theories to explain the passive or insoluble condition of iron. The one generally advanced is that the iron is coated with a continuous impervious film of insoluble oxide. Actually iron is not completely noble in any of the above acid solutions but it is sufficiently inert for most practical purposes.

Iron is more noble in alkaline solutions than in any acid solution. There is less corrosion of the basis metal with alkaline stripping solutions such as sodium cyanide, ammonia, and other alkaline solutions than in acid solutions. The position of zinc in the most active portion of the various activity series indicates the stripping of other metals from a basis metal of zinc to be very difficult.

ABSTRACT OF LITERATURE

Solutions of Nitric Acid and Nitrites

Copper becomes passive[13] in a few seconds at 30°C in a mixture of equal volumes of nitric acid (1.425 sp. gr.) and sulfuric acid (1.24 sp. gr.) due to the formation of a layer of copper sulfate ($CuSO_4 \cdot 5H_2O$) on the copper.

Fuming nitric acid or 3 parts of concentrated nitric acid to one part fuming nitric acid removes[32] copper from steel or iron.

A plate of copper-nickel on steel dissolves[35] in 20 per cent potassium nitrite acidified with acetic acid. Some iron also dissolves.

Sodium nitrite in strong electrolytes[30] exerts a passifying action on iron and some other metals.

Phosphates and sulfates in nitric acid make iron more electronegative and thus decrease its passivity.[65]

Anodic Treatment in Solutions Containing Nitrates

Iron anodes become passive,[2] with the formation of a visible film, in sulfuric, nitric and phosphoric acid solutions.

Passive iron becomes active[4] when rotated at 3000 RPM in the nitric acid. Under proper conditions passivity is shown by most metals. Cobalt, nickel, and copper become passive at —11°C in nitric acid (1.42 sp. gr.) but zinc and magnesium do not.

Metal coatings such as copper and copper-nickel can be removed[37] anodically in alkaline solutions of sodium or potassium hydroxides or carbonates containing nitrates and a reducing agent such as sodium sulfite or glucose.

Passivity of Iron in Nitric Acid

Iron is very active[20] in dilute nitric acid but is passive at concentrations greater than 47%. However, increased concentrations are necessary to maintain passivity at elevated temperatures.

At 20°C iron has a potential of +1.07 volts in strong nitric acid but the potential decreases[19] to +0.90 volts at 50°C.

The presence of urea[20] in concentrated nitric acid decreases the passivity of iron while the presence of most nitrites and some nitrates increase the passivity. Grey

cast iron, high carbon steel and low carbon steel is the order for decreasing ease of passivation.

The surface of active iron is ferrous and the surface of passive iron is ferric.[20, 28]

Chromic Acid Solutions

Copper can be stripped[40] from zinc alloy die castings in a solution of chromic acid-sulfuric acid (100-1) with an alternating current. The temperature should be between 20°C and 25°C and the current density between 7 and 14 amp/sq.dm. in a solution of 200-500 g/l of chromic acid.

A solution composed of chromic acid, 474 g/l,[34, 64] and of sulfuric acid, 50 g/l, strips copper without any current at room temperature.

Other Acid Stripping Solutions

Anodic stripping in sulfuric acid[34] can be used on such basis metals as steel, cast iron, brass, bronze and zinc base alloys but the strength of the acid must not be less than 1.58 sp. gr. (67%). More dilute acid hastens the stripping but increases the attack on the basis metal. In general, acid of 1.7 sp. gr. should be used at the start and some of the old solution, or some ferrous or nickel sulfate should be added, as a new solution has a slower stripping rate than an old one. One per cent of glycerine lessens the attack on the basis metal but increases the stripping time 40 per cent.

The attack of sulfuric acid on iron[32] increases to a maximum with increase in concentration of the acid. Further increases in concentration cause a rapid decrease in the rate of attack which finally becomes very small at high concentrations. In hydrochloric acid, iron is attacked at all concentrations. In nitric acid the degree of passivity varies with the different kinds of iron.

Stannous chloride, gelatin and cresol sulfonic acid[47] inhibit the attack on iron in seven per cent sulfuric acid at 80°C.

The speed of solution[12] of copper in sulfuric acid is increased with increase in concentration of the acid and with increase in the concentration of the copper sulfate formed. Chromates, manganese dioxide, lead dioxide and hydrochloric acid also increase the speed of solution.

An electrolytic stripping bath for nickel[60] consists of 15-20 per cent of sulfuric acid and 63-67 per cent of orthophosphoric acid. The bath can be regenerated by heating and cooling whereby the dissolved nickel salt precipitates. More sulfuric acid should be added as needed.

Zinc alloy die castings are attacked[32] by aqueous solutions, hence some corrosion of the basis metal always occurs, no matter which stripping solution is used. Anodic treatment in trisodium phosphate can be used for stripping some metals such as chromium. Anodic treatment in concentrated sulfuric acid containing a small amount of glycerine can be used. The water absorbed by the solution must be removed either by heating or by the addition of fuming and sulfuric acid.

The rate of solution of copper in sulfuric acid[19] is catalyzed by silver nitrate, iron sulfide, and cobalt sulfide.

The best inhibitors[7] to reduce the activity of sulfuric acid on iron are derivatives of acridine containing several substituted groups, such as 3, 6-dimethyl-2, 7-diethyldiaminoacridine hydrochloride. The inhibitor is absorbed on the iron surface thus increasing the interfacial resistance between the acid and the iron. The inhibiting power of the above compound on iron is 99.8 per cent in 7 per cent sulfuric acid.

Aliphatic amines,[22, 24] such as dibutyl aniline are good inhibitors for reducing the activity of acids on iron.

High concentrations of antimony in very strong hydrochloric acid[23, 52] gives complete protection to iron with no visible separation of antimony and restrains the action on nickel and cobalt. Antimony accelerates the action of the hydrochloric acid on zinc, cadmium, tin, and chromium. Copper and brass are only slowly attacked.

The crystal orientation of copper influences[3, 5] the rate of solution in various acids, both with and without hydrogen peroxide. The attack is more marked when there is no regular orientation. For most solvents the 111 face has the greatest and the 100 face the least solubility.

The rate of solution of metals[9] in acids is proportional to the acid concentration and the difference between the anode and cathode potentials of the local voltaic elements.

The rate of solution[27] of copper in acids,

is increased by oxidizing agents such as hydrogen peroxide, ferric salts and quinone.

Alkaline Solutions Containing Ammonium Hydroxide

Copper dissolves[36, 51, 72, 77] in cupric ammonium carbonate solution containing an excess of ammonium carbonate. This reaction reduces the cupric ammonium carbonate to the cuprous state which is not a solvent for copper until it has been oxidized with air to the original cupric ammonium carbonate state. Copper is recovered by distillation of the solution which leaves a residue of copper oxide while the ammonia and carbon dioxide in the distillate can be used for preparing a new stripping solution. Theoretically, there is no loss of solvent, only oxygen of the air is consumed and this reappears in the final copper oxide. This process is used commercially on a large scale for recovering copper from scrap brass clad steel resulting from the production of bullet jackets. The zinc is not recovered.

Copper can be stripped[58] in a rapidly circulating solution of ammonium carbonate (50-90 g/l) while air is passed in simultaneously.

Copper and its alloys may be removed[41] from iron in ammoniacal solutions with the assistance of oxygen. Bleaching powder is a very effective oxidizing agent.

Although copper dissolves readily in ammonia when anodic, only about 10 per cent[51] is recovered on the cathode.

Various aliphatic halides[8, 31, 69, 70] (trihalogen compounds are best) hydrolyze in water whereby acids are produced that corrode metals. If ammonium hydroxide is present, copper dissolves very rapidly but there is some corrosion of iron. Trichloracetic acid in ammonium hydroxide dissolves half its weight of copper. Halogen compounds, such as carbon tetrachloride and chloroform, that are insoluble in aqueous ammonium hydroxide react slowly with copper unless alcohol is added to increase their solubility. A suitable stripping solution consists of equal parts of concentrated ammonium hydroxide and alcohol plus enough carbon tetrachloride to saturate the solution. Zinc and cadmium will also dissolve.

Copper may be removed from iron by anodic treatment[59] in a solution of ammonium sulfate and ammonium hydroxide.

In absence of air,[36] copper is practically unaffected in either ammonium hydroxide or in ammonium chloride solutions.

Copper can be dissolved[43] by anodic treatment in a bath containing ammonium hydroxide and ammonium nitrate.

Trivalent arsenic, preferably in a mixture with a thiocyanate, reduces[46] the corrosion of iron in ammoniacal ammonium nitrate solutions.

Ammonium sulfate as a leaching agent for copper[72] offers no advantages over ammonium carbonate.

The rate of corrosion of copper[15] in weak solutions of ammonium hydroxide, nitric acid and ammonium nitrate decreases in the order given.

A brass deposit on iron can be dissolved[44] in cold ammonium persulfate, $(NH_4)_2S_2O_8$.

Cyanide Solutions

Copper may be recovered from scrap[20, 56, 75, 76] such as shell cases, by deplating in cyanide solutions such as 10 per cent potassium copper cyanide, 1-2 per cent potassium cyanide and 2 per cent sodium carbonate. A current density of 0.5 amp./sq.dm. and a potential of between 1 and 1.3 volts should be used. When stripping is almost complete, the potential should be adjusted to less than 1 volt.

The solubility of copper[71] in a solution of potassium cyanide, 35 oz./gal. with an alternating current of 20 amp./sq.dm., decreases continuously as the frequency increases. Iron, less soluble than copper, has a maximum solubility at 30 cycles/sec. Nickel and cobalt are more soluble than iron while platinum is less soluble although it does dissolve appreciably. The cyanide solution decomposes at 100°C without any current. Electrolysis of cyanide with iron electrodes and an alternating current yields 30 per cent of ferrocyanide at 15°C. and 63 per cent at 100°C. From 90 to 95 per cent of the cyanide can be changed to the ferrocyanide. Formate and ammonia are formed during the electrolysis.

The dissolving of copper[73] in cyanide with an alternating current depends upon the formation of a complex ion.

At room temperature[66] and a current density of 0.5 amp./sq.dm., nickel dissolves in a chloride-cyanide solution. Increasing temperature increases the activity but increasing current density decreases activity.

No method for stripping copper from nickel-silver and other copper alloys is satisfactory.[31] If the cyanide method is used, the article must be removed as soon as the coating has dissolved to avoid etching of the basis metal. The cyanide method is satisfactory for the removal of copper from iron, steel and Britannia metal.

A temperature of 120°F and a potential of 6.8 volts[32] is recommended for stripping copper in cyanide solutions. Agitation of the article tends to prevent pitting. Chloride increases the attack on the iron. The cyanide concentration is not critical but 8-15 oz./gal. is usually used.

In a sodium cyanide solution, 16 oz./gal.,[34] copper dissolves anodically although basic salt films precipitating on the work may prevent uniform stripping, unless removed by scrubbing or bright dipping.

Copper, brass and bronze[32] dissolve from iron at 130°F. in a 10 per cent solution of sodium cyanide to which 30 per cent hydrogen peroxide is added as required.

Sulfide-Cyanide Combinations

A patent[42] covers the stripping of copper plated zinc articles in separte solutions of sulfides and a cyanide. The copper sulfide first formed by immersion in a solution of a sulfide or polysulfide is subsequently removed by immersion in a solution containing a cyanide of an alkali metal.

The sulfide solution[31] can be made by dissolving 2 oz. sulfur in a solution of sodium sulfide, 28 oz./gal., maintained at the boiling point. After 5 minutes immersion in the sulfide solution the article is removed, scrubbed with a stiff brush to remove any loose metallic sulfides and then returned to the sulfide solution. This procedure is repeated several times to insure complete conversion of the copper to the sulfide. Then the article is put in the cyanide. The sulfide-cyanide method should not be used for stripping copper from steel containing more than 0.25 per cent of carbon.

Elemental sulfur can react[74] with copper without the intervention of sulfides.

A copper sulfide layer 1/16 inch thick forms[72] in four minutes on copper immersed in molten sulfur. This copper sulfide layer is brittle and can be easily scaled or broken from the iron. An objection is the large quantity of sulfur remaining on the work.

In solutions[64] composed almost entirely of sodium pentasulfide (Na_2S_5) the rate of increase in thickness of the copper sulfide layer is proportional to the pentasulfide content of the solution and inversely proportional to the thickness of the layer. An analogous result is obtained with sulfur vapor.

Comparative tests[57] to determine the time required to remove .001" of copper at 25°C by chromic acid with alternating current, sodium cyanide used anodically, and the sodium sulfide (Na_2S_2) — cyanide method gave the following results: 41, 28 and 6 minutes respectively.

Recovery of Copper from Stripping Solutions

Copper[18] can be recovered from copper nitrate solutions by electrodeposition.

Copper can be reclaimed[68] electrolytically from baths containing alkali cyanides, ammonium salts, amides and nitro-substituted organic compounds.

High Temperature Stripping

Scrap, such a webbing that has no reuse value, can be melted[55] whereby the copper separates from the steel and can be drained off.

Copper or brass can be removed[14] from iron alloys by immersing in a molten slag at a temperature between the melting point of the iron and that of the plate.

Gild metal or brass clad scrap can be heated[72] to a temperature below the melting point of the brass whereby 50-60 per cent of the copper and zinc form easily detached oxides. The remaining coating must be removed by some leaching process.

COMMERCIAL AND PROPOSED METHODS FOR STRIPPING

These stripping methods have been submitted as processes either in use commercially or as proposed processes. Recorded here are the claims or suggestions of the

donors which have not yet been substantiated by experimental work in this program.

CHEMICAL METHODS

Chromic Acid Solutions

A formula[79] is chromic acid, 64 oz./gal. and sulfuric acid, 7 oz./gal. This solution will strip .001" of copper in 25 minutes at room temperature and in 5 minutes at 160° F. One serious objection to the chromic acid process is the economic impossibility of recovering the copper.

Immersion[80] in a solution of chromic acid, 50 g./l. and of sulfuric acid, 50 g./l. at 180°F. is used to remove copper after carburizing.

Cyanide Solutions

Copper can be removed[83] from iron by simple immersion in sodium cyanide but the method is slow and expensive because of the large quantities of cyanide needed.

Compositions and conditions of operation are not very critical[85] for stripping by immersion in cyanide. This is indicated by this description of the method; the defective work is stripped in a hot saturated solution of sodium cyanide and the solution is discarded when it operates slowly.

Nitric Acid Solutions

Strong nitric acid,[84] preferably refrigerated to 60-70°F., will dissolve copper and may render the base metal passive.

When using strong nitric acid,[82] the work must be dry and the temperature must be kept below 60°F. Iron is not passive in dilute or hot nitric acid.

Ammonium Solutions

Ammonium persulfate solution, 5 to 20 per cent by weight, added to double the volume of ammonium hydroxide, rapidly dissolves[87] copper and does not attack the base metal unless the solution becomes acid.

Another formula[88] uses copper nitrate, 10 g./l., carbon dioxide, 60 gm./l. added as ammonium carbonate and copper carbonate, and ammonia, 90 g./l. added as ammonium carbonate and ammonium hydroxide. Continuous additions are necessary for maintaining the bath. Optimum conditions are obtained at a copper content of 50 g./l. and the stripping becomes very slow at 100 g./l. To reclaim copper from this solution very high current densities, in the order of 100 amp./sq. ft., must be used.

ACP Actalyte No. 2

A proprietary solution[90] for immersion stripping is called "ACP Actalyte No. 2." The directions for use are:

Two volumes of "ACP Actalyte No. 2" are mixed with 3 volumes of water and then one volume of dilute cold sulfuric acid (1 volume of concentrated acid to 9 of water) is added. The pH must be maintained at between 4 and 5 by the addition of sulfuric acid. More of the ACP Actalyte must be added as determined analytically. A copper coating 0.001 inch in thickness can usually be stripped in ten to thirty minutes depending upon the temperature, agitation and type of copper coating.

Sulfide-Cyanide Solutions

The process using a fulfide followed by immersion in a cyanide is fully described[78] in available trade publications. The essential conditions of operation are immersion of the work for five minutes at 180°F. in the sulfide solution called "liquid sulphur." The copper is converted to copper sulfide and the article, after washing, is immersed in a solution of sodium cyanide, 16 oz./gal. at 180-200°F. for 3-4 minutes in a new solution or as much as 15 minutes in an old solution. This cycle is repeated until all the copper is removed. Each cycle will remove between .001" and .0013" of copper at 160°F. but only .00035" at room temperature. Another advantage of working the sulfur solution at the higher temperature is that the copper sulfide is more flaky and brittle. Pressure washing, after the sulfide treatment, will break off much of the copper sulfide and thus save cyanide. Cyanide is destroyed by the sulfide solution, hence thorough washing is economical before introducing an article into the cyanide. These things are important as three pounds of cyanide are required to dissolve one pound of copper sulfide. The accumulation of reaction products in the cyanide solution finally causes excessive sludge formation on the work and makes it nec-

essary to discard the solution. Steel tanks are satisfactory for both solutions.

Another recommendation[79] is immersion for 5 to 10 minutes in a solution of liver of sulfur, 16 oz./gal. After rinsing, the articles are immersed for about 5 minutes in a solution of potassium cyanide, 21 oz./gal., or sodium cyanide, 16 oz./gal. Optimum results are obtained at 120°F. although the solution may be operated at room temperature.

Another procedure for steel articles[80] is to immerse the parts in 12 per cent "liquid sulfur" at room temperature for one minute. After washing, the work is immersed for two minutes in 20 per cent sodium cyanide at 180-200°F. This cycle is repeated as often as necessary. This process is used for stripping precision parts. Die castings are immersed for 10 to 60 seconds at 160-180°F. in "liquid sulfur," 66 per cent by volume. The cyanide solution, 10 per cent by weight, is used at 200°F. for 10 to 60 seconds. The cycle is repeated as necessary.

Another variation of the sulfide-cyanide method[81] employs sodium polysulfide, 35 oz./gal. at 180°F. The analytical control of the solution is by titration with standard iodine solution. Addition of sodium hydroxide speeds up a sluggish solution but too much alkali etches the base metal. Addition of more sulfide solution restricts the etching action. Steel tanks are used for all solutions. The sodium cyanide solution, 5-6 oz./gal. is used at room temperature for about five minutes. The polysulfide solution penetrates .001" of copper in 15 minutes.

In the "liquid sulfur-cyanide process[82] calcium cyanide plus sodium hydroxide is suggested as a way to conserve sodium cyanide.

Sometimes there is difficulty[83] in replating die castings stripped by the sulfide-cyanide process unless the casting is repolished to remove the film, consisting presumably of zinc sulfide.

Acetic Acid-Sodium Nitrite Solution

A solution of acetic acid and sodium nitrite[91] strips copper from iron without excessive corrosion of the iron.

ELECTROCHEMICAL METHODS

Cyanide Solutions

This method is suggested by many correspondents. The solution and conditions of operation, fully described in work sheets available to everyone[83] are as follows:

Bath Composition	Optimum	Limits
Copper cyanide	6 oz./gal.	5-8 oz./gal.
Sodium cyanide	2.0 oz./gal.	8.1-9.1 oz./gal.
Free sodium cyanide	8.6 oz./gal.	1.5-2.5 oz./gal.
Trisodium phosphate	8 oz./gal.	6-10 oz./gal.
Caustic soda to give pH of	12.2 (elec.)	12.0-12.3

A temperature of 180°F., a cathode to anode ratio of 2:1 and circulation of the solution are important. The potential range, 2-2.2 volts, is critical as the stripping rate is low at lower voltages and at higher voltages the current losses on the steel increase rapidly. The stripped copper is deposited on the cathode in a satisfactory form for reuse as anodes in plating operations. A stripping rate of .001" in 15 minutes may be attained. The work should be cleaned before deplating. The steel is etched at a pH below 11.9. Trouble in controlling the pH may be caused by too low a temperature, too high a voltage or too low cathode efficiency. The last traces of copper may be hard to remove if the potential exceeds 2.2 volts due to polarization, if the pH is too high, or if the work is not properly cleaned. Smut may remain on stripped articles that have been treated in a carburizing furnace. A hydrochloric acid pickle, 50 per cent by volume, usually removes such films.

Another formula[79] for stripping in cyanide is copper cyanide, 4 oz./gal., potassium cyanide, 8.4 oz./gal., potassium hydroxide, 2 oz./gal., and potassium carbonate, 5 oz./gal. The bath is operated at 180° F., 2-2.2 volts, 50-60 amp./sq. ft. and preferably with agitation. The free potassium cyanide is maintained at 2.4-2.6 oz./gal. The stripping time for .001" of copper is 15 minutes. After carburizing, the copper is removed anodically in a solution of sodium cyanide, 12 oz./gal. and sodium hydroxide, 4 oz./gal. at a potential of 6 volts. Slight agitation of the work quadruples the stripping speed. In complete stripping in the cyanide bath is sometimes finished in a chromic acid bath.

The addition of copper cyanide[92] in the preparation of the cyanide deplating solu-

tions is unnecessary as the copper plates out quickly.

Nitrates

A solution of sodium nitrate, 32 oz./gal. operated anodically at 120-140°F. removes[85] brass without attacking the steel. The work is slightly agitated. An ammonium nitrate solution may be used anodically for the same purpose.

Anodic stripping[86] is performed in a solution of sodium nitrate, 96-112 oz./gal. at a potential of 5-12 volts, a current density of 40-75 amp./sq. ft., and a temperature of 130-180°F. The pH is maintained at about 8 by additions of nitric acid, although a lower pH can be used at a lower temperature and a higher pH at a higher temperature. A pH below 7.8 tends to corrode the basis metal and above a pH of 8.2 stripping is too slow. Sodium chloride causes pitting. Additions of sodium nitrate are made on the basis of analytical determinations.

Unichrome Strip

The Unichrome Strip for copper uses a proprietary material[89] for the anodic stripping of copper. The solution containing Unichrome strip salt,[81] 32 oz./gal. is operated at 90-110°F., 9-12 volts, and current density of 100-300 amp./sq. ft.

Conditions of operation are not very critical although too low a temperature lowers the stripping rate, and too high a temperature increases the ammonia loss and may cause etching of iron. A thickness of .001" of copper can be removed in 10 minutes. The special advantage claimed for this process is that the iron is left clean, free rinsing, and virtually free from etching and pitting. If the speed of stripping decreases or if the density of the solution falls below 20°Be, more of the salt should be added. The bath is discarded whenever an addition of the salt does not improve the stripping action.

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(*Continued on page* 719)

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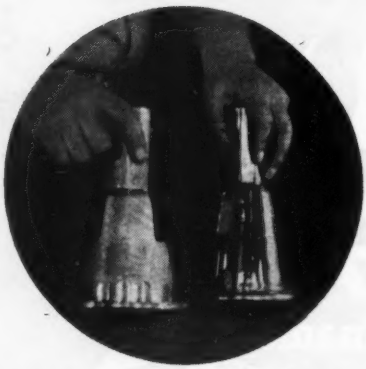

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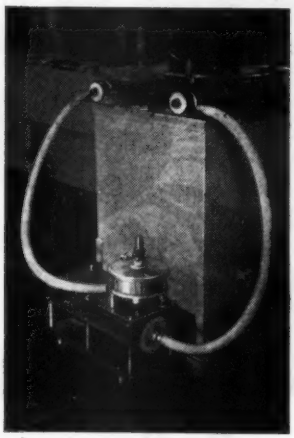

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Supersonics (or ultrasonics) are sound vibrations of such high frequency that they are inaudible to the human ear. The best of human ears can hear no sound which is repeated more than 18 kilocycles per second (a kilocycle is one thousand cycles). Dogs have the ability to hear up to about 30 kilocycles, and some of you may have seen those special dog whistles can be heard only by dogs. The frequency for contemporary supersonic work lies in the range of 1.5 to 800 kilocycles with most of present-day work being done at from 30 to 500 kilocycles.

Production of Supersonics

Supersonic vibrations can be engendered by a variety of mechanisms, the two most important being piezoelectric and magnetostrictive. The piezoelectric effect consists of the development of an electrical charge on the surface of certain crystals when they are subjected to mechanical stress. The converse effect is used here, whereby an electric charge produces a mechanical strain. Thus the application of an oscillating electric charge on one crystal face produces mechanical strains which cause the crystal itself to oscillate. The magnetostrictive effect is the changing in length, by a very minute amount, of a ferromagnetic rod or tube when it is brought into a magnetic field. This slight change in length is with fluctations in the magnetic fields, and can be made to oscillate at anywhere from 30 to 300 kilocycles per second. The disadvantages of the magnetostrictive system are its limitation of top frequency and its great dependence on temperature.

Therefore, the piezoelectric generator emerges as the most important. The piezoelectric effect has been observed in many assymmetric crystals, namely: quartz, Rochelle salts, tourmaline, zinc blende, sodium chlorate, tartaric acid, cane sugar, etc. Of these, only quartz, Rochelle salts and tourmaline are used commercially with quartz being by far the most important and predominate.

Applications of Supersonics

A good example of the large pressure gradient built up by bombardment with supersonic vibrations is illustrated by the work of Mark. He has stated that high order polymers are reduced by exposure to supersonic vibrations with a fracturing of the chemical bond, which necessitates a pressure gradient of several thousand pounds per square inch. Another illustration of the force of these supersonic waves is their action in loosening the crystalline structure of ferro-magnetic alloys.

With ordinarily immiscible liquids such as water and oil, or water and mercury, it is possible by supersonic vibrations to produce very stable emulsions. Carrying this dispersion effect into the field of metals Marinesco dispersed such metals as sodium, potassium, caesium, mercury, lead, zinc, tin, copper, as well as several fusable alloys in alcohol, water, and oil. These lows melting point metals and alloys were placed in a molten condition in contact with the water or oil and the interface exposed to supersonic radiations; this produced particles of the order of magnitude of about .5 microns. Marinesco proposed the explanation that the radiation pressure of the supersonic wave at the bounadry between the liquid and metal lifted a layer of metal of the same order of dimen-

sion as the wave length of the supersonic wave employed, and that this layer of metal then disintegrated into tiny spherical particles.

Raschevkin and Ostrowsky produced ultra-fine emulsions of mercury, sulphur, tin, bismuth, lead, copper, and silver in water; the lead, sulphur, tin, and bismuth formed true colloidal solutions with the particles as small as 10^{-6} cm. so that a true Tyndall effect was discerned. They stated that if the colloidal particles are other than spherical, there is a tendency for these particles

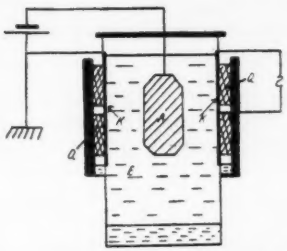
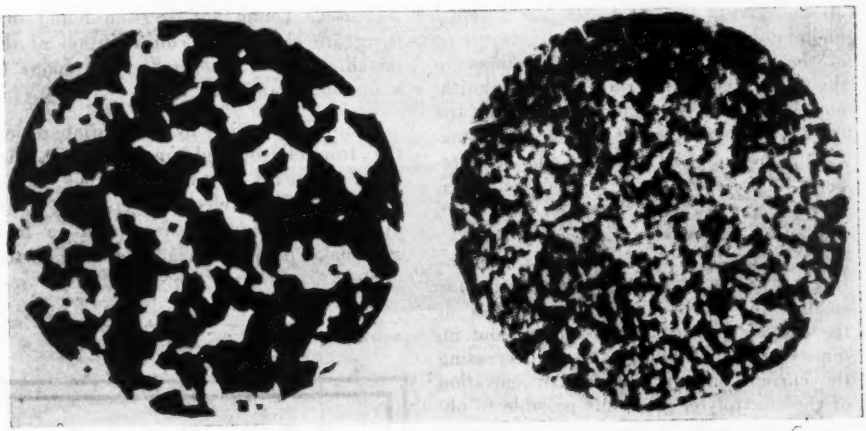
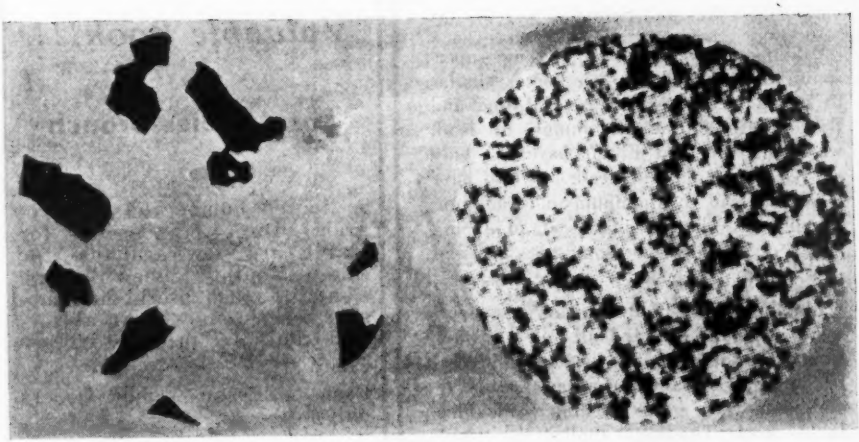


Fig. 1.—Diagram of experimental equipment for dispersion of metals during electrolysis by supersonics.



(a) (b)



(c) (d)

Fig. 2.—Effect of supersonics vibrations on particle size of metals: (a) mercury without electrolysis, (b) mercury with electrolysis, (c) silver without electrolysis, (d) silver with electrolysis. x 2000.

to direct themselves with their longest axes normal to the direction of propagation of the vibrations.

Claus set up an interesting equipment for dispersing metals during electrolysis by means of supersonics. A diagram of a suitable model for experimental use is shown in Fig. 1. A is the anode, K the cathodic metal walls of the electrolytic vessel E. By holding the quartz plates Q against these walls and with proper selection of intensity and frequency, the metal coming from the anode is either deposited on the base of the vessel or dispersed as an emulsion of the electrolyte. Fig. 2 shows photomicrographs at 2,000 magnifications of the effects of supersonic vibrations on the particle size of metals, with and without electrolysis. The factors controlling the degree of dispersion are the electrode material, the cathode surface, and the frequency and intensity of the supersonic vibrations. For a cathode material aluminum, tantalum and vanadium 2A steel are desirable because the deposited metal has little adhesion. Particle size can be made smaller by increasing the smoothness of the cathode surface, the frequency and intensity of the vibrations, and by decreasing the current density and the concentration of the electrolyte. It is thus possible to obtain varied particle sizes and to disperse practically all metals which can be separated by electrolysis. This work was reviewed by Claus and Schmidt.

Making use of the effect of these supersonic waves which produce forces similar to strong mechanical stresses, Masing and Ritzau have alloyed aluminum with lead, while Schmidt and Ehreit have not only alloyed aluminum with lead, but also have dispersed lead in aluminum and cadmium in silumin. The possibility of producing mixed crystals by supersonics is discussed in a paper by Seeman.

Making use of that property of supersonic vibrations which blasts off an outer layer of metal, Thiemann has been successful in applying a tin coating directly to aluminum with no intervening oxide film. In his work, Thiemann applied the supersonic vibrations to the aluminum sheet as it was dipped in the molten tin bath. The rapid back and forth vibrations of the particles of tin in the molten bath, with the great momentum that the high frequency oscillation produces, causes the oxide layer on the aluminum to be literally knocked off and to be replaced immediately by a layer of tin which is actually alloyed with the aluminum surface. This same effect, it is believed, will work for the other light metals in the aluminum series.

There have also been observed some interesting electrochemical effects. Marinesco found that the e.m.f. of a cell is changed by intense supersonic radiation as though the solution pressure of the metal were increased. Young and Kersten found that there are changes in concentration of the metallic ions in the nodes and loops of a stationary wave.

It is hoped that by this brief review the frontiers opened up by supersonics will be brought into focus, so that the inventive genius of electroplaters will recognize the value of supersonics as a tool, and make its fruits available to industry.

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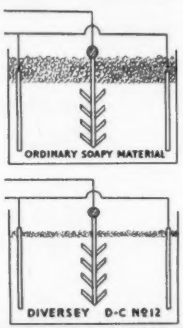

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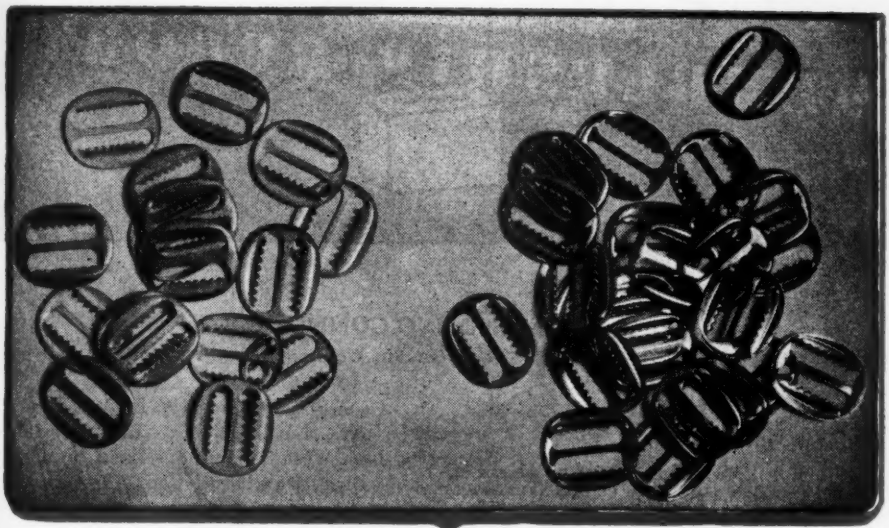

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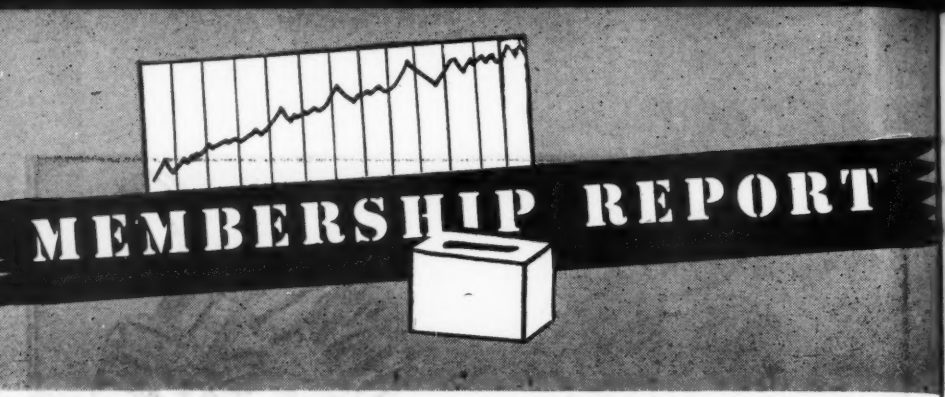

RAYMOND J. O'CONNOR

Chairman, Membership Committee

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Harry Gottleib, Columbus Plating Co., 1319 Tremont St., Roxbury, Mass., Active

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Franklin H. Wells, 323 S. Cameron St., Harrisburg, Pa., Associate

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Fred Mandola, 2 Elm Ct., Metuchon, N. J., Associate

Anthony J. Monari, T. C. Wheaton Co., Millville, N. J., Associate

Joseph Paul Majeske, T. C. Wheaton Co., Millville, N. J., Associate

Gilbert C. Ruckel, General Electric Co., 1405 Locust St., Philadelphia, Pa., Associate

Wayne Gaddy, Detrex Corp., 12 S. 12th St., Philadelphia 7, Pa., Associate

C. W. Moleton, 891 Serpentine Lane, Elkins Park 17, Pa., Associate

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J. T. Wilks, 704 Hemlock St., Avalon, Pittsburgh 2, Pa., Associate

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Renato Silva, Union Polishing Plating Co., 14 Commercial St., Rochester, N. Y., Associate

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Bruce Bridgement, 19 Adelaid St., Belmore, N.S.W. Australia, Associate

Albert V. Cole, 16 Bayliss St., Wagga Wagga. N.S.W. Australia, Associate

John J. Dale, 25 Hawthorn Rd., Caulfield, SE7, Victoria, Australia, Associate

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No. 126463, Lac. McNamara, F.C., c/o G Section, 5 A.D., R.A.A.F., Allonville, N.S.W. Australia, Associate

Fred J. Henkel, 63 Kameruka Rd., Northbridge, N.S.W. Australia, Association

George R. Trevea, Cor. Mallett & Fowler Sts., Camordown, N.S.W., Australia, Associate

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Howard Hilfinger, Jr., 3826 Regley Dr., Toledo, O., Active

Marion Ely, Route 8, Box 344, Toledo, O., Active

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Kenneth E. Schmeling, 3021 Tyler, N. E., Minneapolis, Minn., Associate

Frank Ireland, 4133 Chowen Ave., So., Minneapolis 10, Minn., Associate

Fred W. Haungs, 160 West 6th St., St. Paul, Minn., Active

Louis P. Guimont, 3034 Garfield St., N. E., Minneapolis, Minn., Associate

A. N. McNeil, 2717 Clinton Ave., So., Minneapolis 8, Minn., Associate

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Jascha S. Nemer, 159 W. Kellog Blvd., St. Paul, Minn., Associate

R. M. Krieger, 386 Rice St., St. Paul, Minn., Associate

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John Prescott, Jr., 855 Eastern Ave., Malden, Mass., Associate

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Carl Matkowski, 46 Waverly Pl., Bridgeport, Conn., Associate

Kenneth J. Lamond, 355 Booth Hill Rd., R.F.D. 18, Bridgeport, Conn., Associate

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Glenn R. Schaer, 505 King Ave., Columbus, O., Associate

Waldemar P. Ruemmler, 505 King Ave., Columbus 1, O., Associate

Paul Dever Miller, 505 King Ave., Columbus 1, O., Active

Richard F. Ennis, Jr., 505 King Ave., Columbus 1, O., Associate

John G. Beach, 505 King Ave., Columbus 1, O., Associate

Bernard Agruss, 505 King Ave., Columbus 1, O., Active
Wilbur G. Hespenheide, 505 King Ave., Columbus 1, O., Associate
Ivor Igelsrud, 505 King Ave., Columbus 1, O., Active
Burt Edward Friedl, 505 King Ave., Columbus 1, O., Active
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Stephen E. Timmons, 76 Brickman Ave., O., Active
Nicholas S. White, 410 Chevy Chase Rd., Mansfield, O., Associate
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Walter W. Denney, 330 W. Spring St., Columbus, O., Active
William J. Balzer, 171 E. Fifth Ave., Columbus, O., Active
Jesse V. Parker, 2420 N. James Rd., Columbus, O., Active

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Walter L. Born, 39 Outlook Ave., W. Hartford 7, Conn., Active

Rochester Branch

Frank C. Tinsdale, 86 Boston Rd., Rochester, N. Y., Associate

Toronto Branch

R. H. Greene, 107 Durie St., Swansea, Ontario, Associate

CHANGE OF STATUS

Rockford, Illinois Branch

J. Walker Eaton, 1321 Third Ave., Rockford, Ill., from Associate to Active

REINSTATEMENT

Springfield Branch

James A. Rabbitt, Upland Dr., Greenwich, Conn., Active

TRANSFERS

Howard W. Hindes from Springfield Branch to Boston Branch
Frank H. Schladen from Dayton Branch to Columbus Branch
William Neill from Dayton Branch to Columbus Branch
David S. Stoker from Dayton Branch to Columbus Branch
Charles L. Faust from Dayton Branch to Columbus Branch
Leon L. Haas from Dayton Branch to Columbus Branch
Thomas F. Lavery from Dayton Branch to Columbus Branch
Eugene Combs from Dayton Branch to Columbus Branch
Harold Bulkowski from Dayton Branch to Columbus Branch
William J. Cartheuser from Dayton Branch to Columbus Branch
Harold A. Skinner from Dayton Branch to Columbus Branch
Wilson B. Green from Dayton Branch to Columbus Branch
Hugh A. Teague from Sydney (Australia) Branch to Melbourne (Australia) Branch

RESIGNATIONS

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Hartford Branch

Doris J. Lowe
John F. Chappele
Burton S. Hubbell

Los Angeles Branch

Walter Finnegan

SUSPENSIONS

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Peter Pawlyk
Ray H. Hathaway

Philadelphia Branch

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H. J. Hackenburg
W. F. Harvey

Sydney (Australia) Branch

Edward Hamilton

Syracuse Branch

F. W. Carpenter
John R. Conway
Louis Lowenstein
David W. Hitchcock

DEATHS

Toronto Branch

Thomas O'Keefe

CORRECTION OF PREVIOUS REPORT

Hartford Branch

Thomas Finn, active member not suspended
J. J. Pernal, resigned, not suspended.

MEMBERSHIP CHART

BRANCH	May 1945	Change in Membership	Percent Change
FIRST GROUP			
PHILADELPHIA	154	+11	+ 7.2
CLEVELAND	143	+ 5	+ 3.5
NEWARK	213	+ 6	+ 2.8
DETROIT	390	+10½	+ 2.8
BOSTON	157	+ 3½	+ 2.2
LOS ANGELES	151	+ 3	+ 2.0
BRIDGEPORT	118	+ 2	+ 1.7
GRAND RAPIDS	121	+ 2	+ 1.7
CHICAGO	357	+ 3½	+ 1.0
INDIANAPOLIS	112	+ 1	+ .9
WATERBURY	122	+ 1	+ .8
BALTIMORE-WASH.	123	+ 1	+ .8
ST. LOUIS	116	—	—
TORONTO	119	—	—
NEW YORK	191	—	—
HARTFORD	126	— 6	— 4.8
SECOND GROUP			
PITTSBURGH	80	+ 3½	+ 4.4
ROCHESTER	90	+ 3	+ 3.3
PROV.-ATTLEBORO	101	+ 3	+ 3.0
BUFFALO	89	+ ½	+ .6
MILWAUKEE	107	—	—
NEW HAVEN	106	— ½	— .5
DAYTON	109	— 6½	— 6.0
THIRD GROUP			
ROCKFORD	23	+ 9½	+41.2
TWIN CITY	52	+12½	+24.1
AUSTRALIA	51	+10	+19.6
TOLEDO	54	+ 9	+16.7
SYRACUSE	57	+ 4	+ 7.1
SAN FRANCISCO	55	+ 3	+ 5.5
LANCASTER	39	+ 2	+ 5.1
SPRINGFIELD	73	+ 1½	+ .7
JACKSON-LANSING	62	—	—
CINCINNATI	57	—	—
MONTREAL	54	— 3	— 5.5

Membership May 1, 1945 = 3972
Membership July 1, 1945 = 4077

Gain in Membership = 105
Percent of Gain = 2.6

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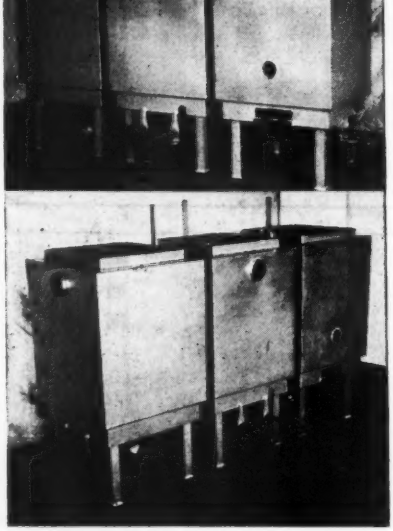

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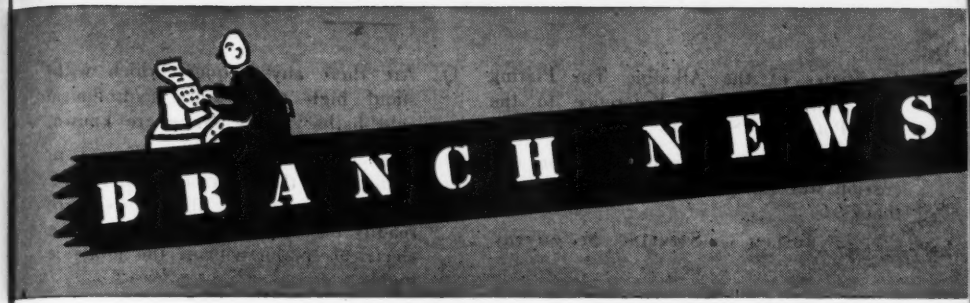

*EDITOR'S NOTE: *Because of space limitations, it has been necessary to condense the Branch Secretaries' reports.*

BOSTON BRANCH

Boston Branch met Thursday, June 7, at the Statler Hotel, Boston, with President Swift in the chair. Two applications were read and turned over to the Board of Managers for approval. The amendments from Washington-Baltimore and Newark Branches were turned over to the delegate of the Branch to use his own judgment. Louis V. Gagnon will take over the Chairmanship of the Research Committee from Bob Magnuson.

The following officers were elected for the coming year: President, Robert Magnuson; 1st Vice-President, Ernest Callahan; 2nd Vice-President, Louis V. Gagnon; Secretary-Treasurer, A. W. Garrett; Librarian, Leonard A. Chesworth; Board of Managers, Arthur W. Collins, Charles, A. Hardy, and Roy Roscoe; and Sergeant-at-Arms, Manson Glover. They were installed by Past President Arthur Mintie.

Our Librarian, Lennie Chesworth, introduced the speaker, Mr. Frank C. Mesle of Oneida, Ltd., Oneida, N. Y. His subject was "Management in the Plating Room," a new one to some of the members who gained valuable information. Some samples were passed around. Mr. Mesle answered all questions put by members and was given a rising vote of thanks.

A. W. GARETT, *Sec'y-Treas.*

BRIDGEPORT BRANCH

The regular monthly meeting was held Friday, May 4, at the Hotel Barnum, President H. C. Braun presiding. Thirty-six members and guests were present including all officers. William Ehrencrona, chairman of the Banquet Committee, gave a complete report on the banquet to be held at the Stratfield Hotel Ballroom on May 26, 1945 at 7 P.M. Hubert M. Goldman, Membership Chairman, reported that Bridgeport Branch was leading the second group as winner. The Publicity Committee reported progress. The Projector Committee reported that the film and sound projector is available to any member of our Branch. The Sick Committee reported that Mrs. Joseph Sexton, wife of our friend Joseph Exton, has passed away. The Bridgeport Branch members expressed their deepest sympathy with a floral offering.

F. B. Gotthardt, Librarian and Chairman of the Technical Sessions Committee, announced that the evening's talk on Magnesium would be given by Ray Kwasnik, one of our foremost members.

President H. C. Braun appointed the secretary to represent the Bridgeport Branch on the Cooperating Committees of the Community Advisory Service Center which deals with problems of conversion from war to peace. The Branch voted to instruct its delegates to vote in favor of the Baltimore-Washington Branch amendment.

An open meeting and educational session was held Friday, May 18, 1945 at 8 P.M. at the Hotel Barnum with 48 members and guests present. President H. C. Braun opened the meeting and after a brief talk called upon C. C. Helmle to preside as Technical Chairman. Mr. Helmle called upon F. A. Lowenheim, of the Metal and Thermit Corporation, as the speaker of the evening whose subject was "The

Properties of the Alkaline Tin Plating Bath with Particular Reference to the New Potassium Stannate Solution."

The very interesting and educational discussion was rewarded by a rising vote of thanks.

JOSEPH G. STERLING, *Sec'y-Treas.*

CHICAGO BRANCH

The Chicago Branch held its regular meeting at the Midland Hotel on Friday, May 11, 1945. The amendments to the By-Laws were read and instructions given to the delegate, Mr. Frank Savage. The new officers for the year were installed by H. A. Gilbertson.

Our Librarian, Mr. C. W. Carter, introduced Dr. MacMullen, Technical Director of the Cowles Detergent Co. of Cleveland, who gave a very interesting talk on "Wetting Agents" with demonstration of their stability, wetting, dispersing, and emulsifying power.

After the meeting refreshments were served at a social gathering that lasted about an hour and a half.

M. H. LONGFIELD, *Secretary*

COLUMBUS BRANCH

The regular meeting was held on Friday, May 25, 1945 at the Battele Memorial Institute. There were 26 members and visitors present.

Mr. L. A. Critchfield of United Chromium, Inc. gave a very interesting talk on "Organic Coatings — the Plater's Tool." Recent developments in rack coatings, stop-offs and solid resists were featured. At the conclusion of the talk the following questions were asked and answered:

Q. Is there a compilation of data on physical and chemical properties of coatings similar to Plastic Handbook? A. No known source. Resins and stop-offs are separate.

Q. May a clear Anozinc treatment be applied to a buffed sheet of commercial zinc? — A. Yes, but clarity is not entirely satisfactory.

Q. Are there any lacquers which withstand high temperature hydrofluoric acid baths? — A. None are known.

Q. Why is brazing always preferred to soldering in the construction of racks? —A. Bolten brazing alloy flows more readily into cracks and joints and the electrical conductivity of the joints is higher.

Q. What is the best method for coating a glass jar with wax for laboratory use? —A. Etch the glass with hydrofluoric acid and then heat it to the melting point of the wax.

Q. Discuss voltage drops between brushes and moving copper surfaces. — A. Carbon brushes have a medium voltage drop. At higher speeds brushes with lower copper content are generally better.

Q. Is mechanical dipping worthwhile? — A. Yes, the coating is more uniform.

Q. Would an initial application of a coating greatly reduced with thinner be advantageous? — A. Not advisable. Regular procedure of initially dipping with slow withdrawal best.

Q. Is there any possibility that an odd number of lacquer coats is more serviceable than an even number? — A. Maybe, but has not been investigated.

A vote of thanks was given Mr. Critchfield for his very interesting and enjoyable talk.

DAVID S. STOKER, *Secretary*

LOS ANGELES BRANCH

The Los Angeles Branch met at the Rosslyn Hotel, Monday evening, May 14. Dinner was served at 6:30 with 42 members present. Visitors were John MacDonald of the A. J. Lynch Company, Kurt Renson of Turco, John Mann of the Able Hard Chrome Company, and George Wilkins of General Chemical Company.

George Wilkins gave a talk on "Fluoborates in Plating Baths."

Applications for active membership were received from Harry C. Pierce, and for associate membership from John W. Mann, F. C. Proctor, and J. Q. P. MacDonald.

They were elected and initiated. The resignation of Walter Finnegan was accepted.

Mr. Eldred, chairman of a committee to investigate and present to the Branch information on the ratio of education and advertising matter in the REVIEW, reported that news from the Los Angeles Branch has not been printed regularly. The last printed report on the November, 1944 meeting appeared in the February, 1945 issue. On the committee's recommendation, it was voted to request the Supreme Society to give the Society a statement of the policy and program for the REVIEW so as to stop the present trend which impairs its value. The Committee was discharged with a vote of thanks.

Mr. Rynkof's and Mr. Lamoureux' report for the Program Directory was accepted and the committee discharged with a rising vote of thanks. The Baltimore-Washington and the Newark Branch amendments were read and rejected. Our delegate was instructed to vote "No." Mr. Savage of Chicago was voted to be our proxy, any alternate to be appointed by the Board of Managers.

The incoming officers for 1945 and 1946 were installed by Earl Coffin. Mr. Lamoureux, on behalf of the Branch, gave retiring President Sunderhaus a gift of a pocketbook.

The Los Angeles Branch held its regular meeting on Monday evening, June 11, Hotel Rosslyn, dinner at 6:30. Forty-nine members were present together with the following visitors: H. L. Haney of the Harshaw Chemical Company, Lynn Reynolds and E. W. Wildes of Adel Precision Company, Mr. P. D. Hess of the Aluminum Company, George Rossner of Douglas Aircraft, Clif Pierce of Palace Plating Company, Kurt Renzon of Turco Products, W. T. Grange of the A-1 Plating Company, F. B. Miller, W. DeWar and Mr. D. Southerland of the Harvey Machine Company, and H. L. Slaydon of Lockheed.

The following speakers covered the subject of Chromic Acid Anodizing: Manual Senz of Consolidated Aircraft, Mr. Mozely of Lockheed, and Homer Youngs of Douglas Aircraft.

Mr. R. M. Brummet was elected to membership and initiated. Mr. Eldred read a letter from Mr. Candee in answer to his committee's letter criticizing the REVIEW. No picnic will be held this summer. President Wells spoke of a new meeting place looked into. The secretary was instructed to send flowers to Frank Ruston, ill at the Veterans' Hospital, Sawtelle, and to Harry Schoonover, ill at home.

FRANK J. BUNKER, *Sec'y-Treas.*

NEWARK BRANCH

The regular meeting was held on Friday evening, May 18, 1945, at the Hotel Robert Treat in Newark, N. J., President Louis Donroe presiding. Forty-nine members, including all officers were present Robert R. Sizelove was appointed Chairman of Committee to run the Annual Fishing Trip, which will be the first since the War started. John DeVries was appointed Chairman of the Research Committee for Newark Branch. There will be only one meeting per month during June, July, August and September, held on the third Friday.

The Librarian, Howard Cobb, presented the guest speaker for the evening, Edward W. T. Faint, a charter member of Newark Branch who gave a very good paper entitled "Electroplating in a Changing World" which earned a rising vote of thanks.

The following Question Box was conducted by the Librarian:

Q. What is a good analytical method for chlorides in a chromium bath? — A. Contact Dr. Dubpernell of United Chromium, Inc.

Q. How can heavy scale be removed from iron without attacking the iron?—A. A solution containing 4 oz. ammonium citrate and ¼ oz. of sodium bichromate per gallon will dissolve heavy oxides about ten times as fast as it dissolves iron. For example, scale from wrought iron bolts is removed in approximately ½ hour with the above solution without appreciably attacking the iron.

Q. Will the Bullard-Dunn process remove scale from silicon steel and will it give an etched surface? — A. It will dissolve oxides but will not attack the steel because there is a deposit of tin on the steel as soon as its surface is laid bare.

Q. How can nickel or silver be made to adhere to molybdenum? A1. Clean 10 per cent sulphuric acid and transfer as fast as possible to the plating bath. Nitric acid makes it passive. A2. Treat anodically in an acid nickel chloride bath then reverse the current and plate without removing the part. A thin deposit of nickel is thus formed. Any other metal may then be plated over this. — A3. Potash dip, brush with pumice and water, clean anodically in concentrated sulphuric acid for one minute at 3 volts using a lead cathode. Nickel flash for 5 or 6 seconds at high current density in a sulphate bath with pH 3. Silver may then be plated over the nickel.

Q. Are sodium salts advantageous over potassium salts? — A. No, except for price considerations. Potassium salts are more soluble, permit the use of higher current densities and since their conductivity is greater, the resistance losses in the bath are lower. They are coming back into use.

GEORGE WAGNER, *Sec'y-Treas.*

NEW HAVEN BRANCH

The April meeting was held in the Sterling Chemistry Laboratory on Tuesday, April 3, President Walter T. Lynch presiding. Mr. Joseph Sullivan, Chairman of the Branch Party Committee, reported that Founders' Night will be celebrated on Tuesday evening, June 5 in the Hotel Taft. President Lynch was appointed delegate to the Society's Annual Meeting. Mr. John English was appointed Chairman of the Nominating Committee with George G. Knecht, Robert Mooney, John M. Barry, and Joseph T. Sullivan as assistants.

Technical Chairman William F. Bridgett, introduced the speaker, Mr. L. C. Conradi, Technical Director, Corronizing Division, Standard Steel Spring Company, Corapolis, Pa. Mr. Conradi's subject was "The Corronizing Process of Metal Coating." He was given a hearty vote of thanks for a fine educational evening.

The New Haven Branch held its regular meeting on Tuesday, May 1, 1945 in Hotel Taft, President Walter T. Lynch presiding. Joseph T. Sullivan, Chairman of the Branch Party to be held on June 5, reported his committee is making progress in arranging a lively evening. Jack English has secured the well known prestidigitator, George Morrow, to act as master of ceremonies.

Joseph T. Sullivan of the Nominating Committee recommended the following slate of officers: President, Walter T. Lynch, Metler Bros. Co.; Vice-President, Joseph Cooke, International Silver Co., Secretary-Treasurer, Bernard J. Gaffney, Sargent & Company; Librarian, Dr. H. L. Kellner, Lea Mfg. Co.; Assistant Librarian, Dr. C. F. Gurnham, Whitney Blake Co.; Board of Governors: Henry Creamer, Winchester Repeating Arms Co., George Knecht, Hanson-Van Winkle-Munning Co., and Joseph Sullivan, New Haven Clock Co.; Convention Delegate, Walter T. Lynch. This slate was unanimously elected.

The Technical Chairman, John C. Oberender, introduced Raymond H. Wallace, New England manager of Paasche Airbrush Co., who spoke on "Automatic Production Spray Painting." This paper will be published in the REVIEW. He illustrated his talk with a colored motion picture. Mr. Wallace was given a rising vote of thanks. The meeting then broke up into informal groups discussing the merits of the subject with the genial assistance of Paascshe's Connecticut representative, James P. Creamer.

G. J. GAFFNEY, *Secretary*

PHILADELPHIA BRANCH

President Zurbach opened the May meeting with very few present and three officers absent. Elected to membership were Myer Karlin, active, and Bryce Redman, Frank M. Beausang, Fred Mandola, Anthony J. Monari, Joseph P. Majeske, Gilbert C. Ruckel, Wayne Gaddy, Charles W. Moleton, associates. The report of the auditors was approved as read. The delegate was instructed to use his discretion on the Baltimore-Washington Branch By-Law change and to vote against the Newark Branch By-Law change.

Philadelphia Branch approved the following resolution presented by Albert Hirsch

— WHEREAS, The American Electroplaters' Society is an educational society, with a philosophy to advance the science of electroplating, BE IT RESOLVED, that the Supreme Society of the American Electroplaters' Society use its prestige to have Electroplating taught in the Public School Systems of the United States of America along with the other sciences such as electricity, physics, and chemistry.

There being no opposition, the secretary cast the unanimous ballot for the following officers: President, E. J. Zurbach, Jr.; 1st Vice-President, Henry Orlik; 2nd Vice-President, E. F. Ottens; Secretary, Paul Mentzer, Sr.; Treasurer, George M. Long; Librarian, Albert Hirsch; Board of Managers: George Gehling, Joseph Underwood, and Nathaniel Verrell; Delegates: Joseph Underwood, Albert Hirsch, and George Gehling; and Alternates: Harry Brown, Paul Mentzer, Sr., and Nathaniel Verrell. Robert Graham installed the elected officers with proxies for the absentees.

A round table discussion started on ways and means to create better attendance at meetings. The members suggested that the officers meet and formulate plans for the Fall and Winter season. The June, July and August meetings will be dispensed with.

PAUL MENTZER, SR., *Secretary*

PITTSBURGH BRANCH

The last regular meeting until September was held Thursday, May 17, at the Roosevelt Hotel. The Branch was in favor of the amendment proposal of the Baltimore-Washington Branch to change Section 6 of Art. 4 of the By-Laws and also of the Newark Branch amendment, except for allowing each Branch to select is own honorary members. Since the Convention in Pittsburgh will be attended by only one delegate from each Branch, there will be no official business carried on by the various committees for the convention.

The Board of Managers reported on their study of financially supporting the Research Fund. It was decided to pay $1.00 per member from the Pittsburgh Branch to the Research Fund. The Branch Research Committee reported some success in getting financial support from local plating concerns.

The following officers and delegates were elected for the ensuing year: President, S. S. Johnston; 1st Vice-President, Leo Schmitt; 2nd Vice-President, G. A. Jersey; Librarian R. A. Dimon; Secretary-Treasurer, F. R. Keller; Board of Managers: H. F. Saylor, L. E. Lancy, and William Hennessy: Delegate to Convention: F. R. Keller; Alternate Delegate: S. S. Johnston.

Mr. G. Bowman of Standard Steel Spring Company gave a brief demonstration and discussion of a new electromagnetic instrument recently developed by S. Lipson, Frankford Arsenal, to measure thickness of plated coatings on a magnetic base metals. The instrument consists of a soft iron wire in a open end glass tube surrounded by a solenoid. By raising the solenoid the steel wire breaks contact with the plate. The gap measured by a scale reading is referred to a graph which gives plate thickness. Accuracy is said to be ±5 per cent.

FRANK R. KELLER, *Secretary*

SPRINGFIELD BRANCH

The April meeting was held at the Hotel Charles on April 23, 1945, Vice-President Copp presiding. J. A. Rabbitt was reinstated as an active member. Colin Hastie was elected convention delegate.

Librarian Frank Clark then introduced Dr. Walter Meyer, Technical Director of The Enthone Company, who gave a very concise and interesting talk on "Electroplating Upon Aluminum," pointing out that attention to detail is extremely important if an adherent deposit is to be obtained. A discussion and question period followed.

PAUL F. LYMAN, *Sec'y-Treas.*

HARTFORD BRANCH

The final meeting of the season was held on Monday, June 4 as a sport's night at the Stanley Golf Club in New Britain. Golf was enjoyed by members and friends. The crowd then broke up into groups of card players and "bull throwers." The affair was considered a big success by all attending.

F. W. SMITH, *Secretary*

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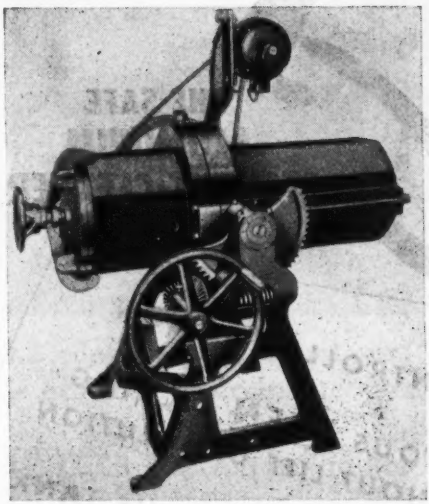

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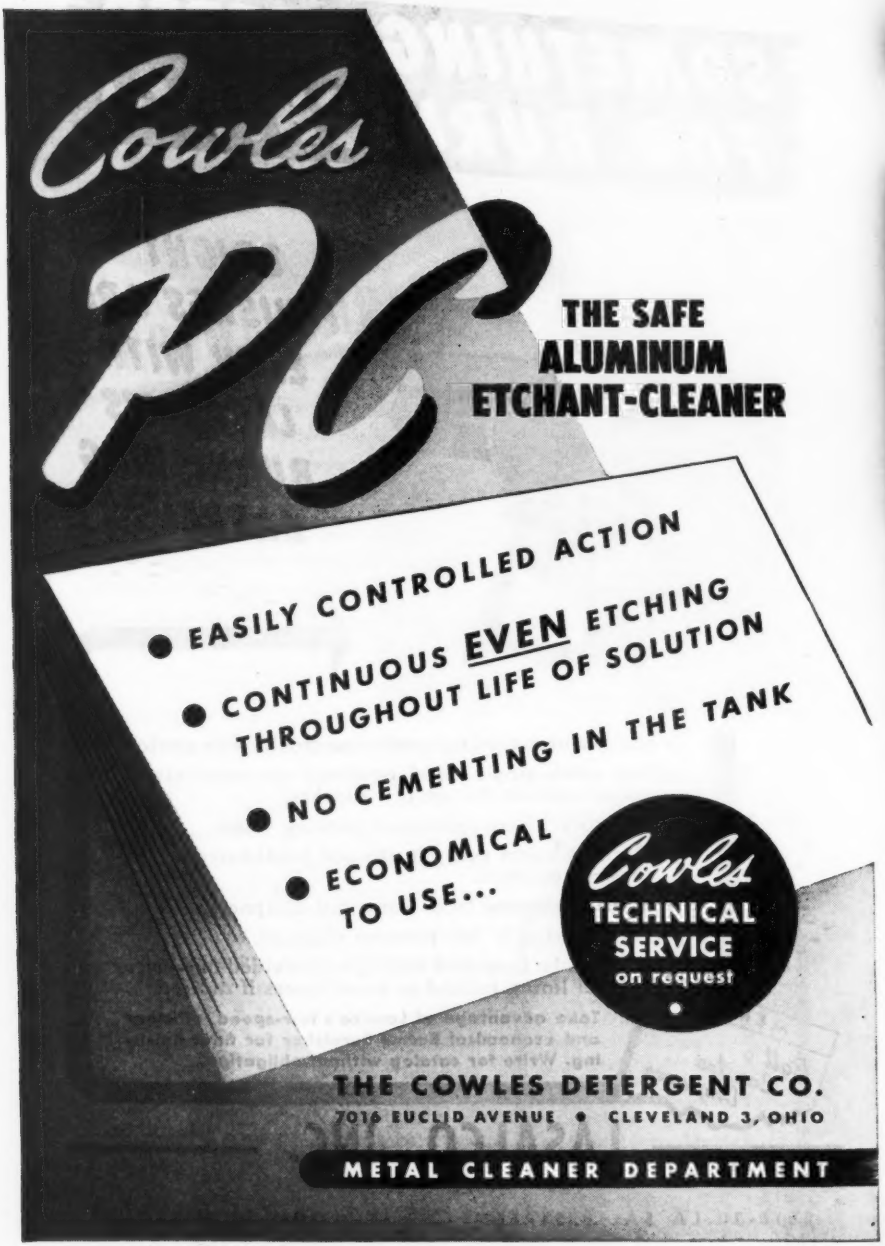
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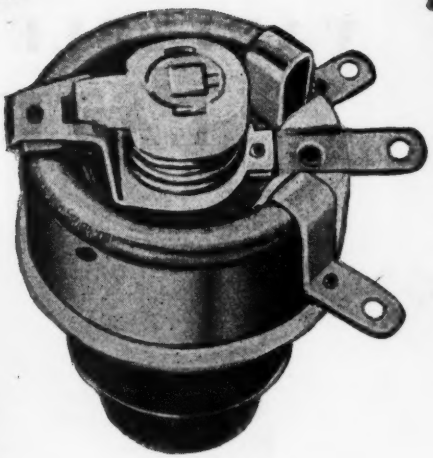

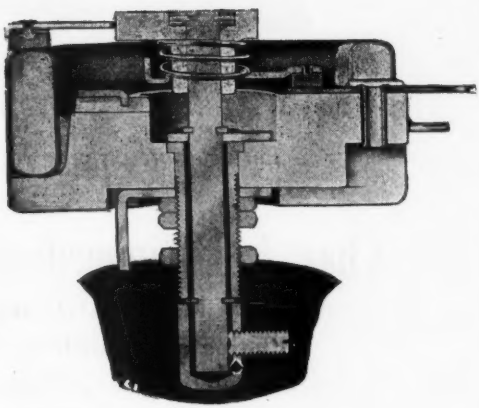

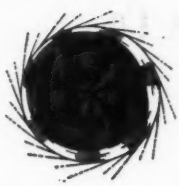

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UNICHROME ALKALINE COPPER for smooth, lustrous copper plating in a non-cyanide bath.

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☆**ANOZINC** salts for anodic treatment of zinc giving greatly increased corrosion-resistance.

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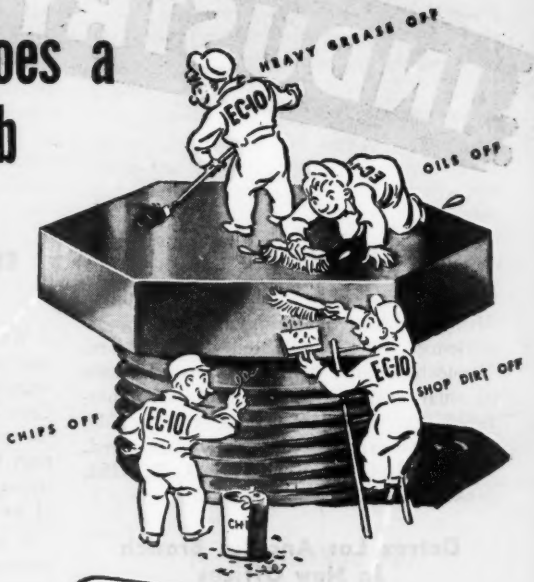
Pennsalt EC-10 does a quick, thorough job

Oils, greases, metal chips and shop dirt are quickly removed from steel bomb fuse plugs in the precleaning process with Pennsalt EC-10. Pennsalt K-7 is used in the subsequent Anodic Cleaning process.

This combination makes it possible for each eight hour shift to produce an average of 9700 fuse plugs with only 1/10 of 1% rejects—a step up in production of 15%.

The following is the actual case history of this operation.



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PROBLEM — To clean steel bomb fuse plugs free of oils, greases and filings prior to zinc plating and subsequent "Iridite" dip coating.

EQUIPMENT USED — A 200 gal. solvent dip tank followed by a spray rinse and a 325 gal. reverse current alkali cleaning tank followed by a dip rinse tank.

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PART 1—PRECLEANING

1. Use Pennsalt EC-10 concentrated, room temperature; soak for 30 seconds.
2. Cold water spray rinse.

PART 2—ANODIC CLEANING

3. Use Pennsalt K-7 at 50 to 100 amps./sq. ft. at 8 oz./gal., 200° F. for 30 seconds.
4. Hot water rinse.
5. Muriatic acid dip.
6. Cold water rinse.
7. Zinc Electroplate.
8. Hot water rinse.
9. Hot "Iridite" dip and then dry air.

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INDUSTRY NEWS

Wanted

Foreman of Electroplating Department Must also have polishing and buffing experience. Factory located in Hartford, Connecticut area. Long time manufacturer of small electrical parts. Post-war opportunities are excellent. Please give full details as to experience and salary expected. MR-Z. MONTHLY REVIEW, P.O. Box 168, Jenkintown, Pa.

Detrex Los Angeles Branch In New Offices

New and larger Pacific Coast Region offices of Detrex Corporation, Detroit, Mich. have been established at 318 West Ninth Street, Los Angeles 15, Calif., telephone TUcker 2578. Mr. S. B. Crooks, Pacific Region Manager, is in charge.

Phillips Chemical Company Appoints New Head

The Phillips Chemical Company is pleased to announce the appointment of Dr. Meyer Agruss as general manager. He was assistant to the plant superintendent of the Titania Pigment Corporation and later in charge of the metallurgical research at the A. C. Smith Corporation in Milwaukee. For the past 10 years he has been associate director of research for the Pure Oil Company.

Second Army-Navy "E" To Vita-Var Corporation

The Vita-Var Corporation, paint manufacturers of Newark, N. J., have won for the second time the Army-Navy Production Award for "meritorious services on the production front."

Electroplating Chemist For Sales Development

We are seeking the services of a young man around 30 years of age who has metallurgical training and a few years' experience in an electroplating shop engaged in diversified operations. We want such a man to demonstrate to customers and potential customers a comprehensive series of new electroplating chemicals.

It is anticipated that such a man will, within a relatively short time, build his position to a point such that he is Product Supervisor in the distribution of a series of electroplating chemicals through already established technical representatives over the entire nation.

In replying, give full details of education and experience, age, draft status, salary expected, and small photograph if available. MR-7A, MONTHLY REVIEW P.O. Box 168, Jenkintown, Pa.

Maas & Waldstein Fetes Veteran Employees

Veteran employees of Maas & Waldenstein Company were honored at a party on the firm's premises, 438 Riverside Avenue, Newark, on June 9. The guest of honor was John Weber, 73, of Bloomfield, N. J., who has spent fifty years with the company. He now superivses the handling of nitrocellulose, which is used in lacquer production.

G. Klinkenstein, Vice-President of the company, presented Mr. Weber with a fifty-year service pin, a diamond ring, and a $500 war bond. He also awarded gold watches and 25-year service pins to five other employees.

Pennsalt PM-90

The Research and Development Department of the Pennsylvania Salt Manufacturing Company announces the development of PENNSALT PM-90, a pickling bath concentrate in electroplating shops and an acid cleaner for removing water scales from boilers and industrial equipment. It contains addition agents for surface action and inhibition and is available in commercial quantities through the Special Chemicals Division, Philadelphia 7, Pa.

Bendix Division Wins Third Army-Navy "E"

The Eclipse-Pioneer Division of Bendix Aviation Corporation has been awarded a new merit star for its Army-Navy "E" flag, it was revealed here today by Raymond P. Lansing, vice-president of the corporation, disclosing production of 12,540,000 units of precision aircraft equipment to United Nations Air Forces during the 1249 days between Pearl Harbor and V-E Day.

Udylite Expansion

To meet the contemplated heavy postwar demand for its products, the Udylite Corporation, of Detroit, has required an additional 16,000 square feet of floor space for the East Grand Boulevard Plant and 15,000 square feet of floor space is being added to the East McNicholas Road Plant.

Penn Salt Announces Promotion and Appointment

Ethel Serfas Klingman, formerly Assistant Manager of Advertising, has been promoted to Manager of Advertising of the Pennsylvania Salt Manufacturing Company effective June 1, 1945, succeeding Mr. H. M. Ellsworth, who resigned on May 1.

Mr. W. P. Drake, Manager of Sales, Special Chemicals Division, announces the appointment on April 9 of Mr. John J. Lance, Field Representative for that Division in the Cleveland-Mansfield-Youngstown area, with headquarters in Cleveland. He was formerly a Methods Engineer with the Bendix Aviation Corporation.

New Coolant For Super-Cut Diamond Wheels

A new Diamond Wheel Coolant specially prepared for use on Super-Cut Zurium Bonded Diamond Wheels has just been announced.

It is said, to cling tightly to the diamond surface forming a film which prevents hot chips from imbedding themselves between the diamond teeth, so that wheels can clean without loading or glazing. Substantially improved finish and 25 per cent more life for Zurium Bonded Diamond Wheels are among other advantages claimed.

The product non-toxic, and non-injurious to skin or clothing is sold as a concentrate which mixes with 20 parts of plain water for application by pump, wick, or drip feed.

Further data may be obtained from Industrial Abrasives, Inc., 3724 W. 38 St., Chicago 32, Ill.

Novel Method For Casting Steel

Development of a special type of thermit, known as "Thermicast," for producing steel castings, has been announced by the Metal and Thermit Corp., 120 Broadway, New York, N. Y.

The new type of thermit is reported to solve the problem of obtaining sound, clean steel castings quickly and simply, irrespective of size and intricacy of shape, when regular steel melting facilities are unavailable. Thermicast is especially designed for the production of steel castings and is not to be associated with welding for which it is not suitable The well-known thermit reaction requiring neither fuel nor electric power, is employed using a specially designed conical-shaped crucible of sheet steel lined with refactory material. Most of the equipment required can be improvised, and little experience to produce steel castings by the process is necessary.

Thermicast is available in 41-lb. bags, each of which produces approximately 25-lbs. of steel. The Thermicast steel, as cast, has the following average physical properties: yield point p.s.i, 39,250; tensile strength, p.s.i., 70,200; per cent elongation in 2", 30.1, and per cent reduction in area. 51.2.

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Research Project No. 1

(*Continued from page 679*)

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Pickling of Steel by Hydrochloric Acid in the Presence of Arsenic Compounds

By UCHENYE ZAP. MOLOTOV. *Gosudarst. Univ.* **3**, No. 4, 101-12 (1939); *Chem. Abstracts* **37**, 5938 (1943).

Arsenic impurity in muriatic acid accelerates the corrosion of steel by the acid, unless it is present in large amounts, which protect the steel from corrosion. In 0.1-2.0 N HCl, more than 0.62 mg./100 cc. arsenic protects the steel. Both effects of arsenic are explained by its formation of colloidal particles at the surface.

ERNEST H. LYONS, JR.

Electrochemical Blackening of Phosphor Bronze

By A. M. NEMENOV. *Korrozia i Bor'ba s Nei* **6**, No. 5-6, 67-9 (1940); *Khim. Referat Zhur.* **4**, No. 7-8, 92 (1941).

Good results were obtained with electrolytes containing NaOH 300-500, $K_2Cr_2O_7$ 30-60 (facilitates the passivation of objects used as anodes) and $(NH_4)_2MoO_4$ 5-15 g./l.; anodic c. d., 2-4 amp./sq. dm., at 80-100°C., Fe cathodes; time approximately 30 min. The throwing power under these conditions was entirely satisfactory. The relation between c. d. and temp. is plotted and must be taken into account in changing the conditions of the experiment. Decreasing c. d. or increasing temp. has a less harmful effect than increase in c. d. or decrease in tempt. After blackening and washing, the objects are placed in a drying oven, where they acquire a dull black finish. No signs of corrosion were observed on immersing such films in a 5% solution of "sea" salt for 300 hrs.

W. R. HENN, *Chemical Abstracts*

Passivation Phenomena During Plating

By A. G. SAMARTSEV. *Trudy Vtori Konferentsii Korrozii Metallov* **1**, 133-47 (1940); *Chem. Abstracts* **37**, 5912 (1943).

The growth of the crystals during electrodeposition is opposed by the formation of absorption layers on the surface of the growing crystals. The deposition of silver from nitrate solutions was studied. After interrupting the current and then applying it again, the previously formed crystals cease to grow, because they are covered by a passive film, and new, growing crystals are formed. The number of nuclei of crystalization depend on the current density, ion concentration and concentration of surface active substances. The fundamental reasons for the change in structure of polycrystalline deposits are given.

ERNEST H. LYONS, JR.

Chromium Alloy Coatings

By E. S. SARKISOV. *Trudy Vtori Konferentsii Korrozii Metallov* **1**, 161-7 (1940); *Chem. Abstracts* **37**, 5934 (1943).

Samples of iron were heated in a porcelain tube containing pieces of 50-50 chro-

mium and aluminum alloy, in an atmosphere of hydrogen and dry hydrogen chloride. The films formed showed good resistance to corrosion and heat. The thickness depended on the temperature used. Chromium-silver alloy coatings were obtained similarly.

ERNEST H. LYONS, JR.

Anodic Behavior of Tin in Alkaline Stannate Solutions

By G. T. BAKHVALOV and P. S. TITOV. *Yubileinyi Sbornik Nauch. Trudov Inst Tsvetnykh Metal. i Zolota 1940*, No. 9, 590-601; *Chem. Abstracts* **37**, 5959 (1943).

The anode potentials at various current densities were studied for three stannate solutions containing 16.1 g./l. Sn and free NaOH 0.31, 0.66, and 1.375 normal. At low potentials the metal dissolves as stannous ions, then on reaching a certain "critical" current density, the potential increases sharply to a value where stannic ions are formed. At still higher current densities ,1.5-10 amp./sq. dm., or 14-93 amp./sq. ft.) there is a second increase in potential corresponding to a discharge of oxygen from hydroxyl ions. If the current density is decreased, the changes in anode reaction occur at lower potentials; by immersing the anode at the correct current density, it is possible to obtain a stable state at which the anode dissolves as stannic ions even at lower current densities. The passivity of the anode results from a protective film formed at high current density; regions not covered by the film have a high current density and high potential; and at the stable state the velocities of the growth and of the solution of the film are equal. The cathode efficiency at 9 amp./sq. ft. was 63-77%, and decreased with increasing current density or NaOH concentration.

ERNEST H. LYONS, JR.

The Effect of Cyanide and Hydroxide Ions in Zinc Cyanide Baths

By P. S. TITOV and N. N. BOLDANOVA. *Yubileinyi Sbornik Nauch. Trudov Inst. Isvetnykh Metal. i Zolota 1940*, No. 9, 580-9; Chem. Abstracts **37**, 5660 (1943).

Increasing the caustic soda and decreasing the cyanide content of cyanide zinc baths: (1) increases the conductivity sharply; (2) increases the cathode polarization, which was found to be chiefly concentration polarization; (3) makes the anode become passive at lower current density; (4) increases the cathode efficiency. In 2.15 normal NaCN and NaOH solutions the deposits have a characteristic luster, which increases with the current density until sponge or burned deposits appear. At higher NaOH concentrations, the deposits are coarse-grained, but with a good even color. The bath recommended gives a cathode efficiency of 98-99% and satisfactory color.

ERNEST H. LYONS, JR.

Fluosilicate in Place of Sulphate in Chromium Plating

By V. I. LAINER and A. A. AVETISYAN. *Yubileinyi Sbornik Nauch. Trudov Inst. Tsvetnykh Metal. i Zolota 1940*, 612-19; *Chem. Abstracts* **37**, 6193 (1943).

The bath with 250 g./l. CrO_3 and 5-10 g./l. H_2SiF_6 has the maximum range of current density for bright deposits. Increasing the H_2SiF_6 concentration decreases the maximum current density at which bright deposits are obtained. Compared with H_2SO_4 in chromium baths, H_2SiF_6 produces bright deposits at lower temperatures (18-25°C., 64-77°F.), gives higher cathode efficiencies and broader ranges of current density for bright deposits.

ERNEST H. LYONS, JR.

Electrodeposition of Nickel in the Presence of Iron

By M. I. MORKHOV and L. P. ATCHI. *Korroziya i Bor'ba s Nei* **6**, No. 5-6, 10-15 (1940); *Khim. Referat. Zhur.* **4**, No. 7-8, 91 (1941).

Fe appears in the Ni bath either as an impurity in the salts used in making up the bath or as a result of partial chemical solution of steel objects being Ni-plated. The effect of Fe on the Ni plate was studied with an electrolyte containing $NiSO_4$, $NiCl_2$, H_3BO_3 and an addition of $FeSO_4 \cdot 7H_2O$ (from 0.1 to 1.2 g./l.); stainless steel cathode plates were used, from

which the Ni film separated easily in the form of films approximately 0.025 mm. thick. The Fe is codeposited with the Ni in amounts approx. directly proportional to its concentration. However, the ratio Fe:Ni in the deposit is 4 times greater than in the solution. In the presence of Fe the plates develop serious internal strains resulting in cracking and peeling. Therefore, the Fe in the electrolyte should not exceed 0.2 g./l. Testing the plates for tensile strength did not give reproducible results. The tensile strength of plates containing no Fe is 95-112 kg./sq. mm. No relation was found between the mechanical properties of the plates and the content of absorbed $H_2 \cdot CO_2 \cdot CO$ and H_2O on the plates.

W. R. HENN, *Chemical Abstracts*

Pickling Embrittlement of Pure Iron at Normal Temperature

By G. CHAUDRON and L. MOREAU. *Metaux and Corrosion* **16**, 124-5; *Compt. rend.* **213**, 790-2 (1941); *Chem. Zentr.* **1942**, **1**, 2323; *Chem. Abstracts* **37**, 5000 (1943).

Pure iron was pickled in a pure sulfuric acid solution for 30 hrs. The hardness rose from 90 to 120 Brinell, corresponding to a lattice distortion produced by the absorption of hydrogen, 120 cc. of which were absorbed per 100 g. iron. The hydrogen was removed by electron bombardment without changing the hardness. After 3 hrs. at 570°F., the hardness returned to 90. Microscopic examination shows that the gas absorption produces an intergranular attack on the metal. Certain substances added to the acid, as Na_2SO_4, increase the absorption of hydrogen and the intergranular attack. The formation of blisters, when the metal has become "pickle short," is shown by the microscope. Cold-worked iron can take up still more hydrogen. Most of the gas is present in the form of inclusions which do not raise the hardness in spite of the great embrittlement, and are slowly evolved in storage at reduced pressure; the iron then loses its brittleness and regains its original toughness, as long as the intergranular attack has not progressed too far. Only a small amount of hydrogen is in solid solution in the lattice, and can only be removed by electron bombardment. Hydrogen embrittles pure iron not in proportion to the quantity absorbed but rather in relation to the condition in which the gas exists in the metal structure.

ERNEST H. LYONS, JR.

Bright Zinc Plating

By E. RAUB and B. WULLHORST. Z. *Elektrochem.* **48**, 342-52 (1942): *Chem. Abstracts 37*, 4972 (1942).

Zinc was deposited from a bath containing 8 oz./gal. NaOH, to which were added various addition agents. Pure baths gave bright plate which quickly became dull even after bright dipping in 0.5% HNO_3. There is a limiting current density, at which the cathode efficiency is 100%, but the coatings are coarse; it is higher at higher temperatures. Outside of this region the cathode efficiency is lower because hydrogen is evolved, but the deposits show a typical fibrous structure which enhances the brightness. The addition of Na_2S, Na_2SO_3, $NaHSO_3$, $Na_2S_2O_3$, $Na_2S_2O_5$ and NH_4CNS in quantities of 0.01-1.3 oz./gal. did not affect the c. d. voltage relationships, nor the structure of the deposits or their hardness, but their brightness was considerably improved by $Na_2S_2O_3$ or Na_2S, although it did not come up to that obtained by polishing. While sulfur seems necessary for the brightening, it cannot be detected in the deposit. Of other reagents added, Na_2MoO_4 was the only one improving the brightness (although not so much as Na_2S); Ge, Va and Ag compounds were decidedly unsuitable; Al, Be, W and Mn compounds were indifferent; and Ni, Fe, Co, Cd, and Hg compounds tended to decrease the brightness of the plates.

ERNEST H. LYONS, JR.

Ford Tumbles Aircraft Engine Parts

ANON. *American Machinist*, **87**, No. 26, Dec. 23, 1942.

Experience of the Ford Motor Company in applying tumbling of Pratt and Whitney engine parts using the "wet stone" method. Tumbling of loose steel, brass, and aluminum parts and parts on fixtures save up to 80% of the man hours required for

burring and buffing and corner rounding operations. Rocker arms, bolts, gears, aircraft motor accessories, drive shafts, nipples, etc. are among the parts described. The fixtures used for holding articles damaged by loose tumbling, are described in detail with sketches.

CHESTER W. SMITH

Chromium Deposition from the Gaseous Phase on Steel and Iron (Chromizing)

By N. S. GORBUNOV and F. S. BARYSHANSKAYA. *Compt. rend. acad. sci. U.R.S.S.* **37**, 277 (1942); *Chem. Abstracts* **37**, 5358 (1943).

Experiments are reported on chromium plating steel by the vapor method. The coatings were examined spectroscopically.

ERNEST H. LYONS, JR.

The Glass Electrodes

By H. J. TENDELOO and A. J. ZWART VOORSPUY. *Rec. trav. chim.* **61**, 531-8 (1942); *Chem. Abstracts* **37**, 5912 (1943).

Attempts were made to prepare electrodes of special glass by which the concentrations of lithium, barium, calcium and hydrogen ions could be determined. Partial success was obtained only in the case of calcium. It was found that absorption phenomena play a significant role in the behavior of a glass electrode. (Note: some day it may be possible to analyze a solution for metal as simply as for pH).

ERNEST H. LYONS, JR.

Immersion Copper Coatings

By ROBERTO PIONTELLI and GUIDO POLI. *Z. physik. Chem.* **A190**, 317-30 (1942); *Chem. Abstracts* **37**, 4972 (1943).

When cadmium metal is immersed in a copper sulfate solution, copper is deposited on the cadmium: $Cd+CuSO_4=Cu+CdSO_4$. There are local cells on the metal surface: the bare cadmium forms the anode, and goes into solution, and the copper deposits function as cathodes. If the cadmium metal is connected to a piece of copper or platinum or other nobler metal, a current flows between the two metals and copper is deposited on the nobler metal. Stirring the solution causes more copper to be deposited on the cadmium and less on the noble metal; the electrode activity of the noble metal is not decreased, but the local cell or battery action on the cadmium is increased by stirring. The theory of the three-electrode system is developed, and three other such systems were studied.

ERNEST H. LYONS, JR.

Chromium-plating By Diffusion—A New Process

By WALTER ECKARDT. Z. *Metall- u. Schmuckwaren-Fabrik. sowie Verchrom.* **23**, 152 (1942); *Chem. Zentr.* **1942**, **II**, 456; cf. C. A. 37, 4633[9].

$CrCl_3$ is precipitated on ceramic material and the articles to be plated are packed in the ceramic material and heated to 950° C. The $CrCl_3$ is decomposed and Cr diffuses into the metal. High C content of Fe hinders the diffusion of Cr.

H. W. RATHMAN, *Chemical Abstracts*

Primers for Aircraft Mg, Al

By G. C. CLOSE. *Ind. Finishing* **19**, No. 9, 50, 55-56, 58 (1943).

Priming is of paramount importance. Al alloys are surface-treated as follows: (1) anodic process, (2) CrO_3 dip process and (3) treatment with H_3PO_4 or phosphate solutions. Mg is surface-treated by the chrome pickle and the Dow treatment No. 7. A primer must be tough and flexible to prevent chipping during handling of the parts prior to application of the finish coat. Zn chromate is the most effective anticorrosive pigment for use with Al alloys. Alkyd resins, combined with phenolic resins are satisfactory primer vehicles. The effectiveness of Zn chromate pigment when used with Mg depends on the conditions to be met during the life of the treated part. It is very slightly soluble in water and under certain conditions causes the chromates to react with oxidation of the Mg, and aids in corrosion prevention. In an acid atmosphere the chromate ion is formed which depolarizes the Mg metal and reduces its corrosion resistance.

W. H. BOYNTON, *Chemical Abstracts*

Compact Magneto-electrolytic Deposits

By ALB. PERRIER, C. MERMOD and E. BESSE-WALTER. *Helv. Chim. Acta* **26**, 1861-9 (1943).

Metals deposited electrolytically under the influence of a magnetic field have unusual physical properties. The experimental technique, apparatus and plating baths are described.

J. K. TAYLOR, *Chemical Abstracts*

Electrotinning and its New Position

By FREDERICK A. LOWENHEIM. *Metals and Alloys* **18**, 795-801 (1943).

Electrotinning lines are designed for strip travel speeds of 300 to 500 lineal feet per min. Electrolytes can be divided into two classes, alkaline and acid. Alkaline baths include the Na stannate-acetate solution and the recently introduced K stannate bath. Acid solutions now in use are: The newly introduced "Halogen" bath of du Pont; the tin cresol-sulfonate solution based on the Schloetter patent; and the stannous sulfate-sulfuric acid based on the patents to Fink. Sn is plated from acid stannous baths operated at or near room temp. Concentration of organic addition agents present must be controlled closely for the production of satisfactory deposits. On the other hand, the alkaline solutions operated at about 170°F., are extremely simple in composition, requiring no addition agents and consisting merely of the alkali metal stannate, the corresponding hydroxide and water, plus carbonate as a harmless impurity. Since the Sn in an acid solution has to be reduced only 2 valences, while 4 valence changes are involved in the alkaline solution, a given number of amp.-hrs. will deposit twice as much Sn from an acid bath as from an alkaline. Current efficiency is generally higher for the acid bath. Cleaning of the strip steel is much less of a problem with the alkaline bath, for the plating solution itself is an excellent detergent, being strongly alkaline and hot and the solution is not corrosive to steel tanks. Electrodeposition is a convenient means of applying a thin coating of Sn which gives a product of wide utility. Its adoption has been greatly stimulated by the Sn shortage.

L. H. SEABRIGHT

Colorimetric Determination of Iron in Chromium Baths

By H. PFEIFFER. Z. *anal. Chem.* **126**, 81-8 (1943).

It is sometimes desirable to learn quickly the concentration of Fe^{+++} in a Cr-plating bath; this Fe^{+++} may come from the walls of the electroplating vessel or from the object which is to be Cr plated. The thiocyanate and the 7-iodo-8-hydroxyquinoline-sulfonic acid colorimetric procedures did not prove satisfactory, but good results were obtained by the colormetric method in which sulfosalicylic acid is used as reagent. The color of the chromic acid itself can be satisfactorily combated by the use of a Na-vapor lamp. The dichromate ion, however, has a sp. effect on deepening the color of the Fe test but error can be eliminated by the use of an empirical table which is given. Diffuse daylight has practically no effect on the determination.

W. T. HALL, *Chemical Abstracts*

A New Method of Improvement of Metallic Surfaces by Diffusion

By H. VOSSKUHLER. Z. *Electrochem.* **49**, 204-8 (1943); cf. *C. A.* **36**, 4449.

Improved corrosion-resisting, heat-resisting and hardness characteristics can be produced on steel, brass, Al-alloy and Mg-alloy sheets and rods by metallic diffusion in inert atms. Examples of nitrided steel, colorized and sherardized Fe, Li or Mg coatings on Al and Ca coatings on Mg are cited. Methods of production are described.

W. A. MUDGE, *Chemical Abstracts*

The Haring Cell for Measuring Addition-agent Concentration in Electrolytic Baths

By W. GAUVIN and C. A. WINKLER. *Can. J. Research* **21B**, 81-91 (1943); *Chem. Abstracts* **37**, 4971 (1943).

Cathodic polarization measurements with the Haring cell in acid copper solutions show that the addition of gelatin increases the polarization, depending on temperature, and such measurements might be used to determine the concentration of gelatin in the bath. To obtain reproductibility, standard surface conditions must be imparted to the cathode by electrolyzing in a standard electrolyte under definite conditions until steady state polarization values are obtained.

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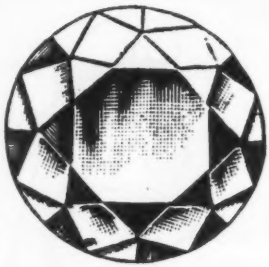

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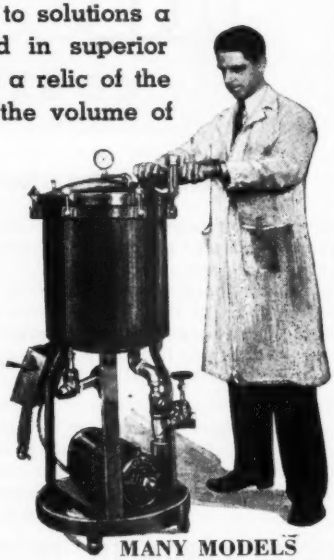

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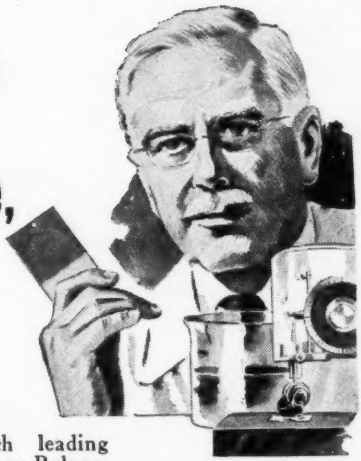

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* Patent applied for

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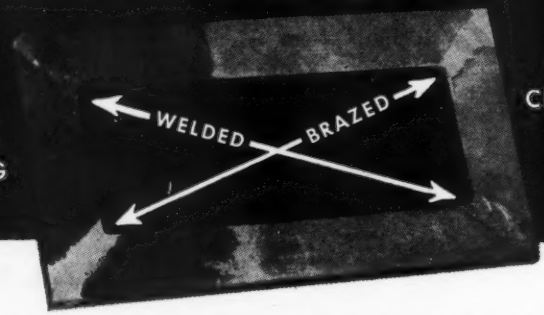
A NEW METHOD of removing flux, and welding or brazing scale



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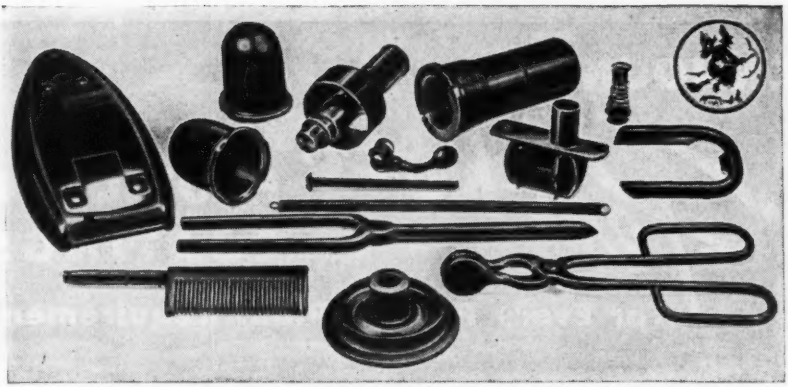

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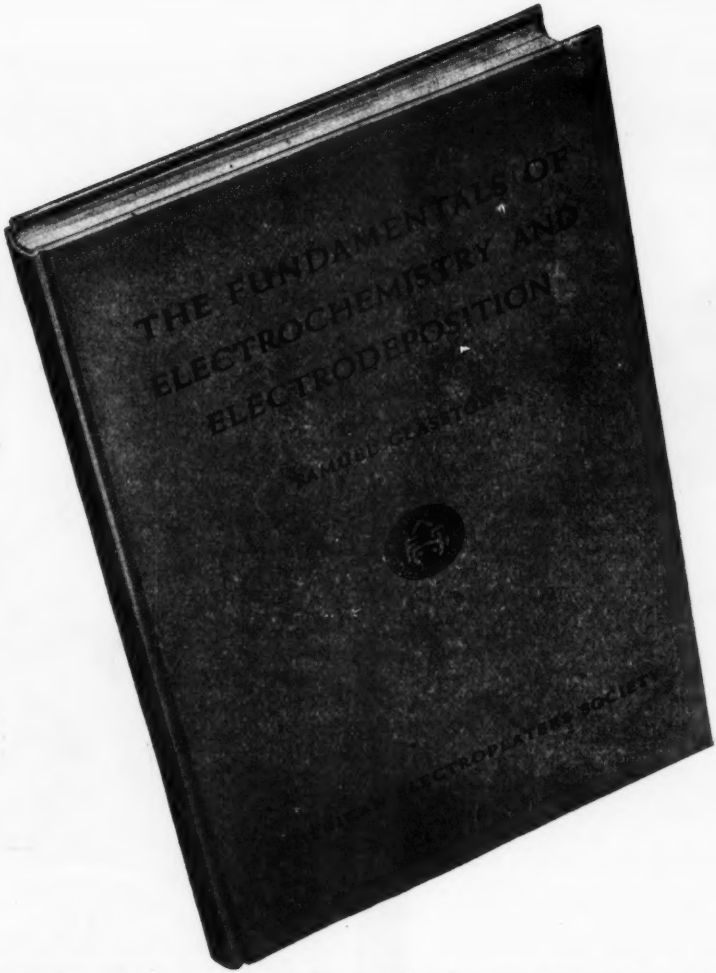

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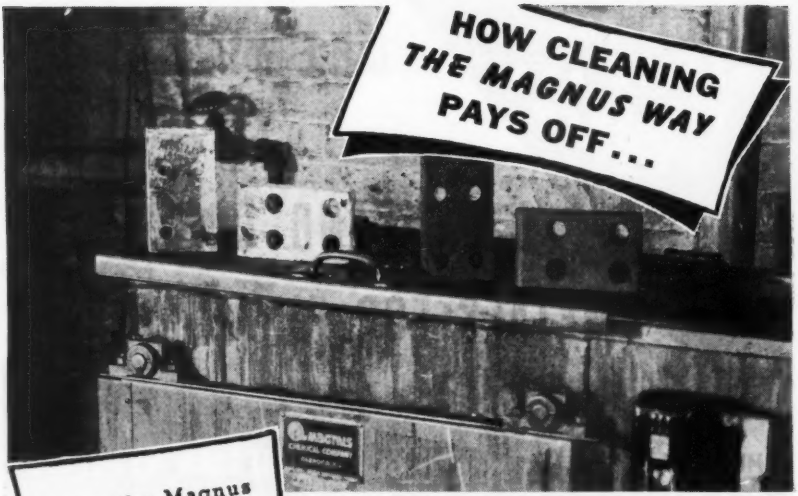

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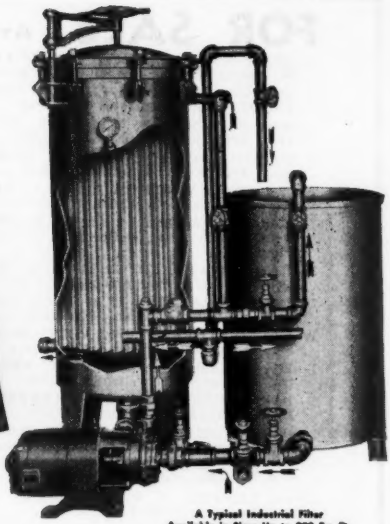

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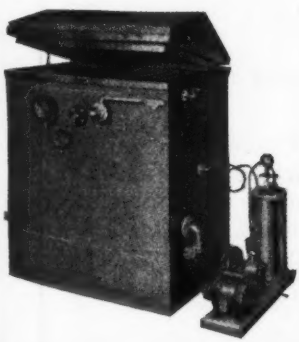

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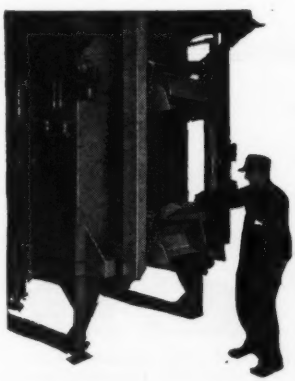

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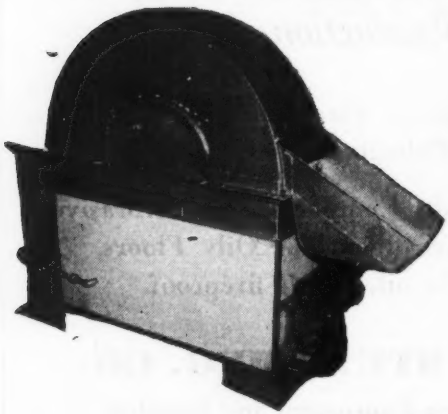

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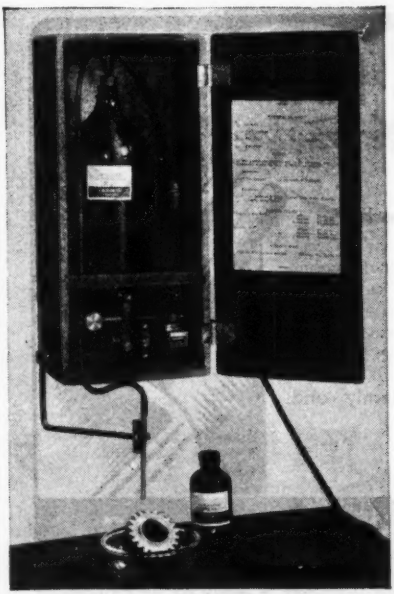

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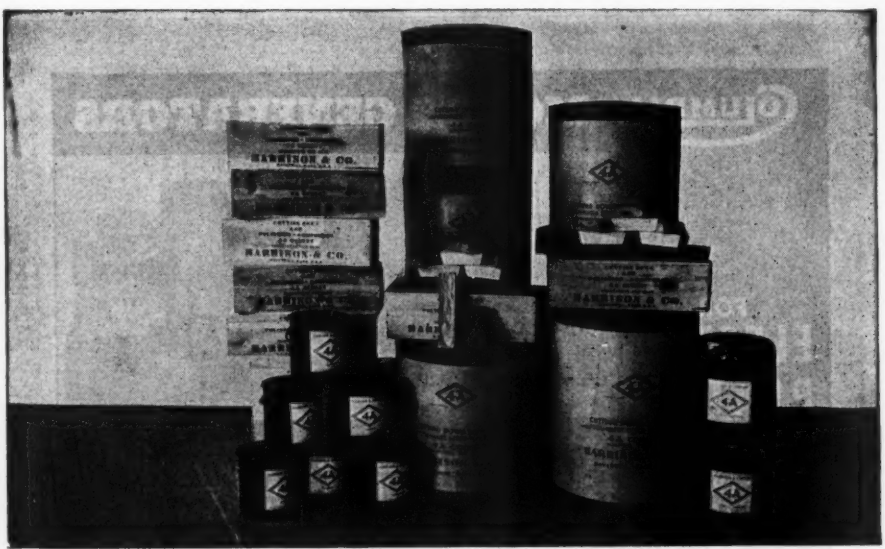

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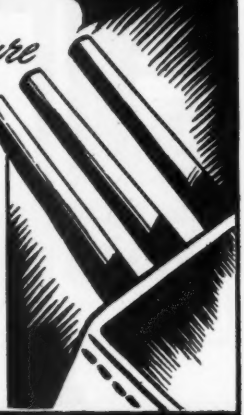

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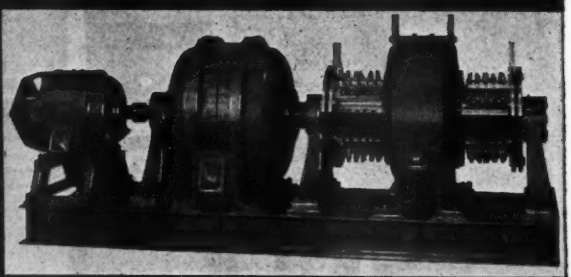

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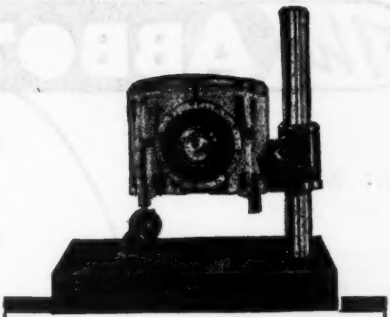

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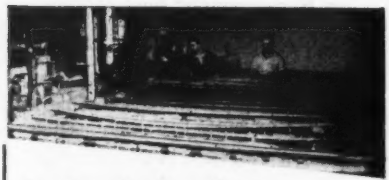

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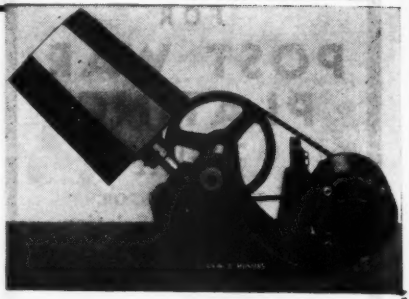

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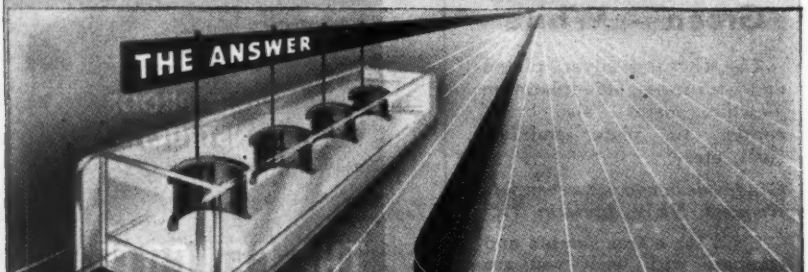

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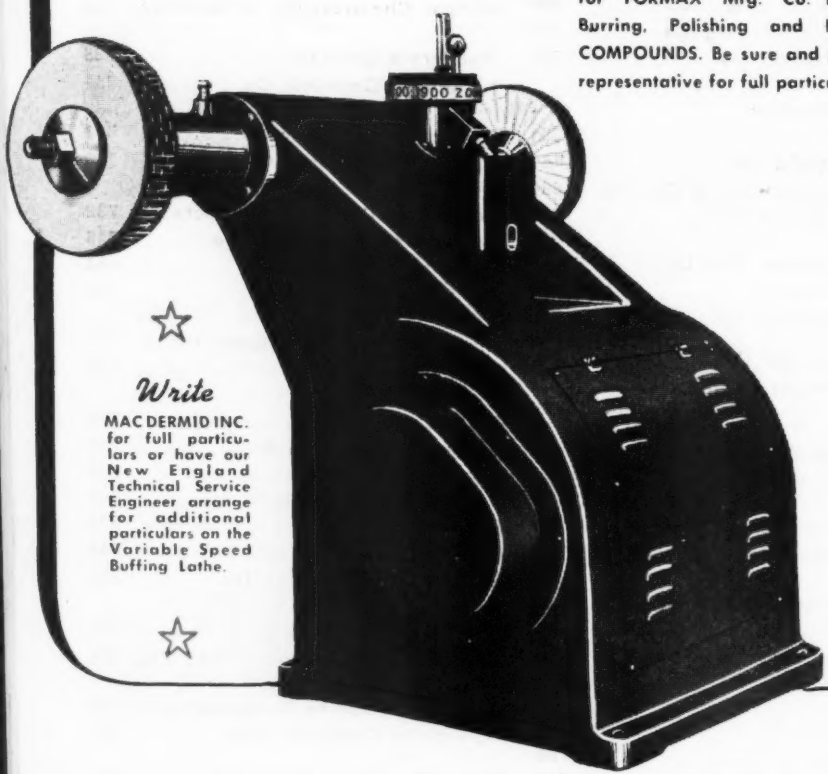

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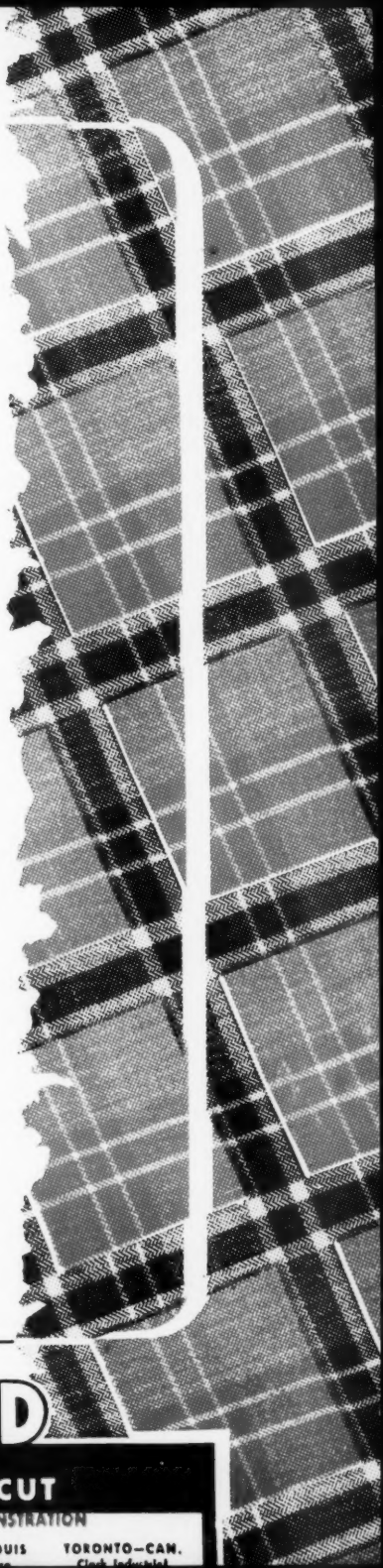

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